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MARCH TO DECEMBER, 1950

WITH 8 PLATES AND 36 TEXT FIGURES

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THE PHILIPPINE JOURNAL OF SCIENCE

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THE ORIGIN OF THE PHILIPPINE FERN FLORA*

By EDWIN B. COPELAND
Of the University of California, Berkeley

It is generally accepted doctrine that floras develop on continents, and spread thence to islands; that, while islands have their endemic species, and sometimes endemic genera, usually locally evolved, floras as a whole are not of insular origin. So, the Philippines, as individual islands and as an archipelago, rich as they are in endemics, owe the parents of these endemics, along with their flora as a whole, to immigration.

Our subject this evening is the source of this immigration. As a matter of obvious geography, it can have three possible immediate sources: (1) Continental Asia, from China to Northern Luzon. (2) From the South-West, immediately, from Borneo. (3) From the South and South-East, immediately from Celebes and New Guinea; eventually from a source which has not until recently been obvious, and not usually even suspected. Large as New Guinea and Borneo are, they are not continents and have not functioned as such.

Ferns are propagated by spores, so small and light that, once taken up by the wind, they can be carried to great distances. Some spores are viable only for a number of days, others for a number of years. In no case is viability so limited as to be a bar to dispersal. Effective limitation is imposed by the mass of spores taken up by the general winds, and by the size and suitability of the target, where the spores come down, and must find themselves in fit places for germination, and then for growth to maturity.

---

* Read before the Philippine Orchid Society, May 24, 1949.

Ferns from Celebes and Borneo find suitable climatic conditions in Mindanao and Palawan. But each species must find suitable local conditions,—lowland or mountain, locally dryish or humid, open grass-land, or the light shade of open woods, or the dense shade of the rain forest, soil, or rocks, or the mossy branches of trees. Some species are narrowly limited as to the places where they can live; others comparatively catholic in their demands. A common species gives off clouds of spores, and is far more likely to effect migration than is a rare species. Thus it is a general rule that common species are wide-spread, and conversely that wide-spread species are likely to be common locally. Also, common species usually become so because they are not very narrowly restricted as to the tolerable habitat.

Our basic evidence as to migration is provided by present distribution; and it must be emphasized that this means by our present knowledge of distribution. A species known only in the Philippines is regarded as endemic, and is only indirectly (by means of argument) available as evidence of origin or migration. If next year it be found in New Guinea or Borneo or Formosa, it ceases to be endemic, and becomes evidence of migration, in one direction or the other. Confidence in our arguments and conclusions depends absolutely on our knowledge of the ferns of the Philippines and of all neighboring lands.

However much the future may still reveal about our Philippine ferns, we already know them well enough to make it almost impossible that future discoveries will materially modify conclusions soundly based on present knowledge. Forty years ago, our knowledge of the ferns of Borneo and New Guinea was so imperfect that the conditions as I see them to-day could not be suspected. During these four decades, so much has been discovered that I can draw general conclusions with a measure of confidence. But it is still true that in detail our knowledge of the sources of our flora will be improved and perfected by collections in other lands, far more than by future local discoveries.

Basic facts as to our fern flora are that 938 species are known. Of these, 444 seem to be endemic, and 494 to be known elsewhere. Of these 494, 62 are known only in lands to the North and North-West,—China, Formosa; these I call the Chinese component of our fern flora. Fifty-seven are known only from the South-East,—New Guinea, the Moluccas, the Admiralty Islands, Minahasa; for convenience, I call these the component of direct New Guinea origin. One hundred thirty-nine are known only to the South-West, the Malay region; because Borneo is our nearest neighbor in that direction, I will refer to these as Bornean. Two hundred thirty-six species, almost half of our non-endemics, have a wider range, including New Guinea and Malaya. This last list includes a few cosmopolitan or Pantropic species, which would not be good evidence, but which are too few to weaken conclusions.

As to the Chinese component of our non-endemics:

46 species are known in the Philippines, except in Northern Luzon or South of China on the continent.

10 species are more or less common in Northern Luzon, and are rare farther South, and do not occur South of China.

6 species are common in the Philippines, but only Northern in Asia.

There are 20 other species restricted in the Philippines to Northern Luzon, but ranging farther South elsewhere, some of them even to Java. If they are immigrants, their origin is uncertain.

Even though Asia be a continent and Luzon an island, a species common to China and Luzon is not sure to have migrated from China. We can say with confidence that the most of them did so, but 15 of them seem more likely to have migrated in the other direction. Of the 62 species known otherwise only from more Northern lands, this leaves 47, less than one-tenth of our immigrant fern species, which seem probably to be immigrants from the North. And this is not to say that any 10 per cent of our ferns are of Northern origin. Of our 444 endemic species, presumably evolved locally from immigrant ancestors, only one-fiftieth are probably of ultimate Northern origin. Of all our species, only about 1 in 17 is of probable Northern origin or ancestry. If you will collect 100 species in a day, which is possible on Maquiling, and easy on Banajao, the chance is good that not one of them will represent the Northern component of our flora.

This Northern component is new here, as is shown by the local distribution of the species, almost all restricted to Northern Luzon, and by the extremely small number of endemics for which it is responsible.

Figures already presented show 57 of our non-endemics in common with New Guinea and only with New Guinea. The corresponding figure for Borneo is 139. If we could properly assume, as we have often done, that all common species are immigrants to the Philippines, it would follow obviously that Borneo has been a far more important source of our flora than New Guinea.

There are geographic grounds on which this had to be expected. Borneo is close to the Philippines, so near to the high island of Palawan, for the transmission of fern spores, they are almost in contact. Also, the small Bornean area which is far the richest in ferns, Mt. Kinabalu, is almost in sight of Palawan, and, as spores travel,. is not remote from Mindanao.

In the other direction, Celebes is more remote, and New Guinea still more so. Also, we know nothing of the fern flora of Halmahera, and practically nothing of that of the Vogelkopf, the great North-Western extension of New Guinea. And Celebes is less well explored than Mindanao or Borneo, or even the highlands of New Guinea, but is believed to have a poorer fern flora, being drier. Imperfection of evidence of course impairs the force of our conclusions. As future collection will add more to our knowledge of the fern flora of New Guinea, Halmahera and Celebes than to that of Borneo, the disparity in the number of species of apparently South-Easterly and South-Westerly ferns will become less conspicuous. However, I do not expect it to disappear. Our mere contiguity to Borneo is reason enough to expect a great number of species in common.

However, our theme is the source of our flora. The number of species in common is important evidence, but evidence which is not to be accepted uncritically, as if it were conclusive. As the winds blow, I can hardly imagine the migration of a fern from Mindanao to New Guinea, but must believe that practically every species common to the two was an immigrant to Mindanao. On the other hand, as the winds blow, it seems to me that a Mindanao fern has been at least as likely to be carried to Borneo as a Borneo fern to be borne to Mindanao. This consideration alone may reduce to parity the probable receipt of immigrants from the two regions.

There is still another very important consideration. We will now recall the 236 species common to the Philippines, New Guinea and Malaya. Assuming with good reason that these did not originate in the Philippines, either they were first in

New Guinea and migrated to Malaya, or were first in Malaya and migrated to New Guinea. The latter alternative used to be accepted without question. To-day, since we have learned the richness of New Guinea in ferns, have more or less learned that the continental source of these ferns was not Asia but Antartica, and have taken cognizance of the direction of the wind which bears the spores, there remains no evident ground for doubt that migration in the tropical Orient has been in general from East to West. Recognizing the fact that the bulk of the fern flora of Malaya,—of the 236 species common to Malaya, the Philippines and New Guinea, and also of the 139 species common to Malaya and the Philippines but not to New Guinea, along of course with the 57 species common to New Guinea and the Philippines only,—is of New Guinea origin, decision as to the origin of the 432 non-endemic Philippine ferns which did not come to Luzon from China is merely a question as to the route of migration,—whether directly from New Guinea to Mindanao, or indirectly, by way of Malaya, or in many cases by way of Borneo but not of Java.

Whatever the route, my conclusion is that about 90 per cent of our non-endemic species are of direct or indirect New Guinea origin.

So far, except for a note regarding our Chinese component, we have ignored the endemics, as if they were without interest in a discussion of origin, which is not the case. The difficulty with their use is that it involves the presentation and interpretation of details, and their full use would extend this short essay to a size more like that of a book. For one illustration: The genus *Haplodictyum* consists of two endemics, ranging from Samar to Cagayan. It is intimately related to a group of 14 endemic species of *Cyclosorus*, largely confined to the same humid East coast, and without known outside relatives except where the first of the group was described, in the Moluccas. Clearly enough, this little derived genus, and these other 14 endemic species, are here as a result of direct immigration from the region of New Guinea.

A NEW SPECIES OF NEMATODIRUS (NEMATODA: TRICHOSTRONGYLIDAE) FROM SHEEP

By SHOU-TAI HSU
*Of the Department of Parasitology,
National Veterinary College, Lanchow, China*

and

BOO-YEN WEI
*Of the North-west Epizootic Prevention Bureau,
Lanchow, China*

TWO PLATES

During a survey on the internal parasites of sheep at Sung San Tan, Kansu Province, North-western China, by one of us (B. Y. W.) in 1948, numerous specimens of a nematode belonging to the genus *Nematodirus* were recovered from three out of ten heads of sheep examined. They were fixed and stored in 70 per cent alcohol. Later, in winter of the same year, the specimens were mounted and studied in the laboratory of the Department of Parasitology, National Veterinary College, Lanchow, Kansu. The description given below is based on twenty-two specimens, ten female and twelve male.

NEMATODIRUS LONGISPICULARIS n. sp.

The body is thread-like and tapers toward the anterior portion, the extremity of which is inflated. The cuticle is marked with a varying number of longitudinal ridges. The perioral structure presents centrally a triradiate aperture, surrounded by three incompletely separated lips, each bearing two prominent round papillae.

Male: length 12.9 to 16.4 mm.; maximum width 0.12 to 0.16 mm. Oesophagus 0.47 to 0.6 mm. long by 0.02 to .022 mm. wide at anterior end, 0.034 to 0.045 mm. at nerve ring and 0.034 to 0.054 mm. at posterior end. Nerve ring 0.21 to 0.29 mm. from anterior end of oesophagus. The bursa is composed of a pair of lateral lobes, devoid of cuticular bosses, and a pair of dorsal lobes, marked off from the former by a slight indentation. The arrangement of the rays is characteristic of the genus. Each of the dorsal rays is bifid distally, with the small outer branch curved laterally. The ventral rays are close together and parallel while the externo-dorsal rays are long and slender. The postero-lateral ray is close to the medio-lateral throughout its length, only diverging from it distally. The externo-lateral ray is widely separated from the medio-lateral at its distal third or half. Spicules are relatively very long and slender, united by a membrane except near their roots. They measure from 6.7 to 10.3 mm. long. The ratio of the length of body to that of spicule is 1: 0.4 to 0.7 with an average of 1: 0.56. The spicules terminate in a spoon-shaped expansion, similar to that of *Nematodirus spathiger* (Railliet, 1896).

Female: length 20.19 to 26.4 mm.; maximum width 0.27 to 0.33 mm. Oesophagus 0.44 to 0.62 mm. long by 0.02 to 0.025 mm. wide at anterior end, 0.036 to 0.047 mm. at nerve ring and 0.04 to 0.055 mm. at posterior end. Nerve ring 0.2 to 0.28 mm. from anterior end of oesophagus. Length of vagina 0.056 to 0.091 mm. Vulva to anterior end of body 5.5 to 9.66 mm. At the anterior lip of the vulva there is a prominent flap, attached to which is a thin membrane covering the genital opening. Tail 0.088 to 0.136 mm. long, somewhat truncate, with a slender terminal spike. Eggs relatively very large, measure 0. 28 to 0.34 by 0.14 to 0.19 mm.

Host: Ovis aries.

Location: Small intestine.

Locality: Sung San Tan, Kansu Province, China.

Type specimen: NVC Helminthological Collection No. 431.

Discussion.—The present species may be differentiated from other members of the genus *Nematodirus* such as *N. spathiger* (Railliet, 1896) Railliet and Henry 1909, *N. filicollis* (Rudolphi, 1802) Ransom, 1907, *N. abnormalis* May, 1921, and *N. furcatus* May, 1921, mainly by its extremely long spicules, the absence of cuticular bosses on the male bursa as well as the presence of an anterior flap covering the vulva.

ACKNOWLEDGMENT

The authors are indebted to Dr. Marcos A. Tubangui of the Institute of Hygiene, University of the Philippines, Manila, Philippines, for his kind help in reading over the manuscript.

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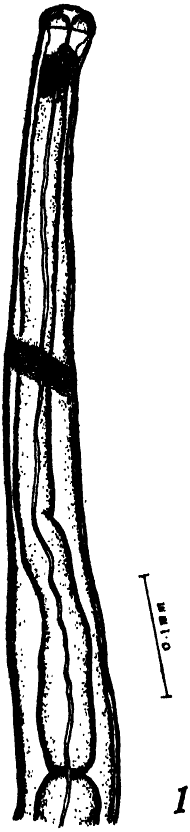
ILLUSTRATIONS

PLATE 1

Fig. 1. Anterior end of female.
2. Ova.
3. Perioral structure.
4. Posterior end of female, showing terminal spike.
5. Lateral view of vulva, showing anterior flap and a thin membrane attached to it.

PLATE 2

Fig. 1. Entire male, showing spicules.
2. Extremities of spicules.
    (*a*) Proximal ends.
    (*b*) Lateral view of distal ends.
    (*c*) Dorsal view of the same.
3. Dorsal view of bursa copulatrix.
4. Lateral view of the same.



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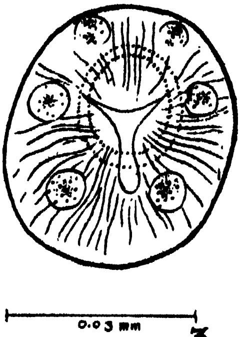

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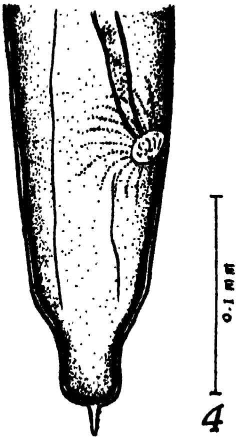

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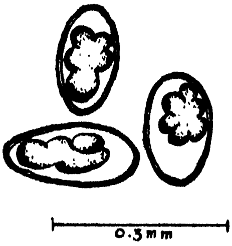

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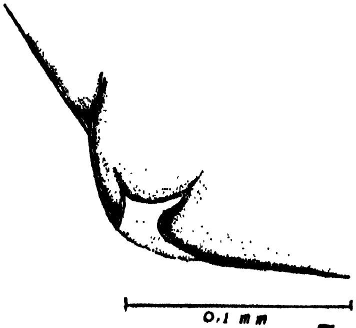

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PLATE 1.

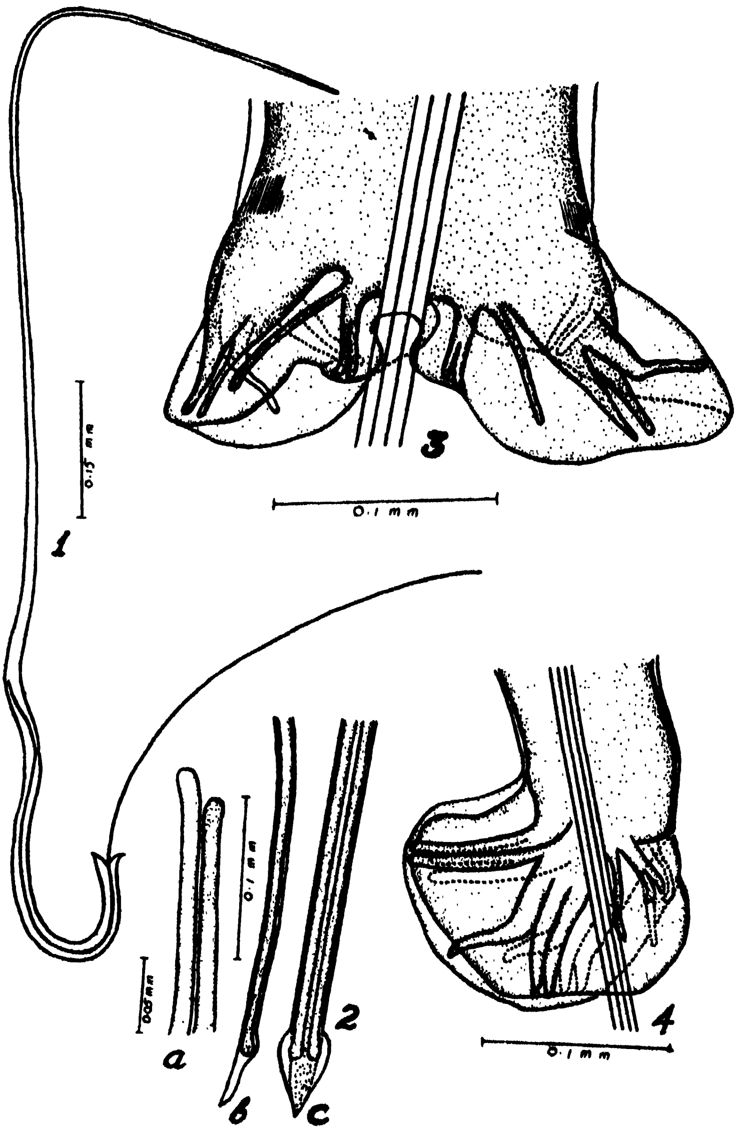

PLATE 2.

THE LAMIINE TRIBE GNOMINI (COLEOPTERA, CERAMBYCIDAE)

BY LAWRENCE S. DILLON AND ELIZABETH S. DILLON
Reading Public Museum, Reading, Pennsylvania

THREE PLATES

The Gnomini form a small tribe of longhorns confined entirely to the Indo-Australian faunistic region. While the species are comparatively few the individual members are frequently encountered and they compose a characteristic feature of the fauna of the area involved. Its components as a whole have never been the subject of a rovisional study, although the species of the genus *Gnoma* were treated in recent years (Schwarzer, *Senckenbergiana*, VIII, p. 279–287, 1926) [1]

The present study is based primarily on the very large collection of the group contained in the United States National Museum, where the major portion of the types has been deposited. Supplementing these specimens were the collections of the following institutions and individuals: American Museum of Natural History [AMNH]; Australian Museum [AM]; Academy of Natural Sciences of Philadelphia [ANSP]; British Museum (Natural History) [BMNH]; California Academy of Sciences [CAS]; E. F. Gilmour, Huddersfield, England [EFG]; Lionel Lacey, New Rochelle, N. Y. [LL]; Museum of Comparative Zoology [MCZ]; Naturhistoriska Riksmuseum, Stockholm [NRS]; and Rijksmuseum van Natuurlijke Historie, Leiden [RNHL].

The authors' thanks are extended to the following persons for arranging for loans and for other favors: Dr. E. A. Chapin; Mr. Warren S. Fisher; Dr. Mont Cazier; Mr. E. T. Cresson, Jr.; Mr. James A. G. Rehn; Dr. H. E. Hinton; Mr. E. F. Gilmour; Dr. E. A. Ross; Dr. J. Linsley Gressitt; Mr. Lionel Lacey; Dr. P. J. Darlington, Jr.; Dr. René Malaise; Dr. C. de Jong; Dr. C. Blöte and Mr. Keith C. McKeown.

TRIBAL CHARACTERISTICS

Elongate-oblong, slender or moderately robust, cylindrical, moderate in size. Head distinctly wider than pronotum, not retractile; front transverse, sides parallel or narrowed below,

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[1] Since this was written Mr. S. Breuning has published a review of the tribe in *Novitates Entomologicae*, suppl. 3, vol. 2.

convex; eyes deeply emarginate, lower lobe transverse; antennal tubercles prominent, obtusely armed at apex; antennæ usually longer in male than female, scape attaining apex of pronotum, clavate with a closed cicatrix at apex; the segments beyond, at least the seventh, strongly shortened. Pronotum elongate, usually extremely so in male; sides armed or unarmed. Elytra with prominent humeri; apices separately rounded; hind wings present. Proacetabula closed behind, angulated externally; mesacetabula open externally. Legs moderate or elongate, first part longest, middle shortest; procoxæ large, globose; protibiæ with a distinct spur near apex in male; tarsi rather long; claws divergent, simple. Abdomen with first sternite elongate, at least as long as next three together.

This tribe is extremely close in its structural characteristics to the Monochamini; the form of the pronotum, the protibial spur of the male, and the distal segments of antennæ suddenly decreasing in length are perhaps the sole distinguishing features.

The genus *Amphoecus* Montrouzier in no way can be placed in this tribe, and hence is omitted here.

Key to genera

1. Pronotum with a distinct tubercle on each side just behind middle .... *Imantocera*
   Pronotum unarmed 2
2. Antennæ densely plumed on apices of third, fourth, and fifth segments .... *Psectrocera*
   Antennæ not plumed .... *Gnoma*

Genus IMANTOCERA Thomson

Imantocera Thomson, Arc. Ent. 1 (1857) 188; Class. Ceramb. (1860) 94, 102; Syst. Ceramb. (1864) 382. Lacordaire, Gen. Col. 9 (1869) 364. Breuning, Nov. Ent., Suppl. 3 2 (1945) 527.
Himantocera Pascoe, Trans. Ent. Soc. Lond. 3 3 (1866) 288.

Moderate-sized beetles; oblong, cylindrical. Head with front transverse, sides parallel; genae subquadrate; eyes with lower lobe large, trapezoidal, subequal in length to gena; antennal tubercles prominent, well separated at base, with a feeble tooth at apex. Pronotum feebly elongate in male, transverse in female, base and apex subequal; sides with a tubercle at middle and another and smaller one below it; disk irregular. Scutellum transverse. Elytra wider at base than pronotum, feebly attenuate posteriorly in male, slightly expanded behind middle in female; disk at base with a series of granules along the apex of a crest, rest of disk with well-spaced, moderate punctures. Prosternum simple; mesosternum with a feeble, obtuse tubercle. Legs feebly elongate, the middle ones shortest. Antennæ one and one-third to one and one-half times as long as body, shorter in female; scape attaining pronotal apex, robust, rugose above; third segment longer than fourth, the apices of third and fourth segments expanded and the inner angle prolonged, the fifth feebly so, densely plumed on apex of fourth.

Genotype.—Thomson included no species with his original description but in 1860 quoted *Imantocera plumosa* Hope? (*penicillata?* White) (*penicillata* Hope).

Key to species

1.	Elytra with preapical macula as large as scutellum or larger	2
	Elytra with preapical macula smaller than scutellum	4
2.	Scutellum pure white; elytra with gray pubescence predominating	*sumbavana*
	Scutellum yellowish-white or fulvescent; elytra with predominating pubescence not gray	3
3.	Elytra with preapical macula distinctly larger than scutellum; antennæ with small tufts of hair on the eighth, ninth and tenth segments in male	*penicillata*
	Elytra with preapical macula about equal in size to the scutellum; antennæ not tufted on distal segments in either sex	*grisescens*
4.	Elytra without any gray pubescence	*niasensis*
	Elytra with at least traces of gray pubescene	5
5.	Elytra very dark, with obscure, deep, broken reddish-ochraceous vittæ	*vicina*
	Elytra paler, with broken vittæ more prominent, ochraceous	*plumosa*

1. IMANTOCERA SUMBAVANA Breuning Plate 3, fig. 3.

Imantocera sumbavana Breuning.

In the antennæ bearing tufts of hair on the apical segments, *sumbavana* resembles *penicillata* of the mainland; but in its smooth pronotal sculpturing it shows its relationship to the other insular forms. It is quite distinct from the latter in its coloration.

Male.—Robust; black, densely covered with chocolate-brown pubescence, mottled irregularly with fuscous on head and pronotum. Head with front sparsely varied with hoary gray and maculate with fulvous below. Pronotum on disk indistinctly variegated with dull fulvous; laterally with an irregular broad hoary vitta, in which is placed a narrow dull fulvous vitta; at base medially a small whitish macula. Scutellum entirely white. Elytra mottled about equally with hoary and light fulvous pubescence (in the single female example which was studied, the latter is absent entirely and the hoary about equalled the chocolate-brown in quantity); before apex an oval, whitish and fulvous macula, larger than scutellum. Beneath piceous, largely hoary pubescent; prosternum, procoxæ, mesosternal side-pieces (these also variegated with dark brown and whitish), and a macula on sides of metasternum and another on metepisterna, fulvous; abdomen on each side with two series of maculæ, the inner fulvous, the outer whitish, becoming fulvous apically. Legs and antennæ dark reddish-brown, hoary pubescent; the latter with third to fifth segments dark apically, the sixth and following segments entirely pale.

Head impunctate except on antennal tubercles. Pronotum slightly longer than wide; apical and basal transverse sulci distinct; disk rather smooth, a low tubercle before basal sulcus on each side of middle, larger tubercle behind apical sulcus placed a little more laterally. Elytra finely, rather densely granulate-punctate on basal fifth, granules larger on crest, seriate, and extending to basal third, thence coarsely punctate to apex, punctures much finer behind apical third. Mesosternum anteriorly with a low rounded tubercle; fifth sternite at apex emarginate-truncate. Protibial spur long, acute. Antennæ one-third longer than body; scape attaining apex of pronotum, densely rugose above; third segment twice length of first, apically scarcely expanded internally, rather roughly punctate; fourth very little shorter than third, medially slightly thickened, then contracted and strongly reexpanded at apex, with a dense plume covering apical half of under surface; fifth segment longer than first, rest much shorter, all bearing small tufts of hair beneath at apex (except the last).

Female.—Like male but more robust; pronotum transverse; fifth sternite longer than third and fourth together, broadly truncate at apex; protibial spur feeble; antennæ as long as body, segments abruptly shorter beginning with fifth.

Length 17 to 22 milimeters; width 5.5 to 7.

Type in Naturhistorische Riksmuseum, Stockholm.

Type locality: Sumbawa.

Distribution: Sumbawa Island.

Sumbawa: ♂, ♀, no locality data [♂ (type)—NRS; ♀—RNHL], ♂ Haruhasa Mountain [EFG].

2. IMANTOCERA PENICILLATA Hope Plate 3, fig. 2.

Lamia penicillata Hope, in Gray, Zool. Misc. 1 (1881) 17.

Imantocera penicillata Hope. Pascoe, Journ. Ent. 1 (1862) 345; Breuning, Nov. Ent., Suppl. 3 2 (1945) 527.

Himantocera penicillata Hope, Gahan, Ann. Mus. Civ. Genoa 34 (1895) 47.

Imantocera plumosa Thomson [non Olivier], Class. Ceramb. (1860) 102.

Imantocera olivieri Thomson, Syst. Ceramb. (1865) 555. New synonymy.

Imantocera arenosa Pascoe, Journ. Ent. 1 (1862) 344. New synonymy.

This species is exceedingly close to *vicina* but is constantly distinct in its paler coloration, the elytral pale apical macula larger than the scutellum, the antennæ in male with small tufts of hair on at least eighth to tenth segments, the fourth segment distinctly expanded medially in both sexes, and the abdomen usually with three series of maculæ each side.

Male.—Robust black, densely covered with fuscous pubescence, variegated with hoary pubescence on elytra and sides of pronotum, and mottled with deep fuscous. Head above variegated with fulvous, sometimes four or five maculæ paler and more distinct, front sparsely variegated with fulvous. Pronotum variegated with fulvous medially and on sides; each side of disk before middle with a single prominent fulvous macula; at base with three whitish marks, the middle one wide along margin, then constricted and sublinear as it extends cephalad, re-expanded anteriorly; each side of disk at middle a rather large pale macula, and another smaller on each median tubercle basally. Scutellum entirely yellowish-white. Elytra each with five distinct, much interrupted, ochraceous vittæ; before apex a prominent pale macula, usually distinctly larger than the scutellum. Body beneath, legs, and antennæ as in *vicina* but the abdomen with three series of maculæ instead of two on each side. Antennæ with fourth segment somewhat expanded at middle, then slightly constricted and strongly re-expanded at apex, with a dense plume covering the entire apical half beneath; the seventh to eleventh segments usually with a small, short tuft of hairs beneath, at least the eighth to tenth so tufted. Rest as in *vicina*.

Length 13 to 20 millimeters; with 4.5 to 6.

Type locality: Nepal (*penicillata*); Siam (*olivieri*); Cambodia (*arenosa*); Assam (*plumosa*).

Distribution: Southeastern Asia.

India: ♀, Dejoo, Upper Assam, July 9, 1910 [BMNH]. 2 ♂, 4 ♀, Chandkiva, Silhet [EFG].

Burma: ♂, Taunggyi, Feb. 1927 [USNM].

Indo-China: ♂, Tonkin [LL] ♂, Choganh, Tonkin [USNM].

♂ Than-Moe, Tonkin [RNHL]. ♂, ♀, Hoo-Binh, Tonkin [USNM]. ♀, Annam [RNHL]. ♂, Phuo-Son, Annam [RNHL].

3. IMANTOCERA VICINA Gahan **Plate 3, fig. 4.**

Himantocera vicina Gahan, Ann. Mus. Civ. Genoa 2 14 (1894) 47.
Imantocera vicina Gahan. Breuning, Nov. Ent., Suppl. 3 2 (1945) 527.

The very dark coloration (appearing nearly black) of the upper surface and the form of the fourth antennal segment will serve to distinguish this species.

Male.—Robust; black, densely covered with fuscous pubescence, sparsely variegated with hoary and mottled with black. Head above sparsely irrorate with fulvous, sometimes four maculæ paler and more distinct; front varied with fulvous, especially on each side and at middle. Pronotum variegated with fulvous medially and on sides of disk; three whitish marks at base, lateral ones small, median one large, extending cephalad to sulcus in the form of a vitta which is of nearly uniform width throughout; on each side of disk at middle a rather large pale macula. Scutellum entirely whitish. Elytra each with five obscure, much interrupted, ochraceous vittæ; before apex a small, whitish macula, about half as large as the scutellum. Body beneath black, fuscous pubescent; maculate with fulvous on sternal side-pieces, on sides of metasternum, and in two series on each side of abdominal sternites. Legs dark brown, fuscous pubescent; femora each with three hoary annuli; tarsi a little paler than tibiæ (which are in turn paler than femora), whitish pubescent. Antennæ dark reddish-brown, dull hoary pubescent, the apical segments often annulate with fuscous.

Head impunctate except on antennal tubercles. Pronotum slightly longer than wide; apical and basal transverse sulci distinct; disk roughly sculptured, an elongate tubercle on each side of middle, each broken into three parts, anteriolaterad of these a rounded tubercle and above lateral spines another less pronounced. Elytra with nearly entire basal quarter granulate, the granules on crest larger and denser, succeeded by coarse punctures posteriorly; crest variable, sometimes short, sometimes continued as a costa nearly to apex. Mesosternum with a prominent tubercle, distinctly produced cephalad; fifth sternite narrowly emarginate at apex. Protibial spur short, dentiform. Antennæ distinctly longer than body; scape attaining apex of pronotum, densely rugose above, third segment twice length of first, punctate above, internally at apex with a distinct process; fourth segment one-quarter shorter than third, at middle only feebly expanded if at all, the apex strongly so, the plume covering the apical half of under surface; fifth segment as long as first, expanded at apex, rest much shorter, without tufts.

Female.—Like male but more robust; pronotum transverse; fifth sternite longer than third and fourth together, broadly emarginate at apex; protibial spur very short; antennæ as long as body, segments abruptly shortened from fifth.

Length 13 to 18 millimeters; width 5 to 6.

Type in British Museum.

Type locality: Burma.

Distribution: Northern India.

India: 4 ♂, ♀, Gopaldhara, Rungbong Valley, Sikkim [BMNH]. 3 ♂ ♀, Pedong, Sikkim [RNHL]. 3 ♂, ♀, Guntok, Sikkim [RNHL]. 10 ♂, 8 ♀, Dejoo, Up. Assam [BMNH]. 5 ♂, Khasia Hills, Assam [EFG]. 2 ♂, ♀, N. Manipur [EFG]. 3 ♂, 2 ♀, Margherita, Assam [EFG].

4. IMANTOCERA PLUMOSA PLUMOSA OLIVIER Plate 3, fig. 6.

Cerambyx plumosa Olivier, Encyc. Meth. Ins. 7 (1792) 463; Ent. 67 4 (1795) 98, *pl. 20, f. 152.*

Himantocera plumosa Olivier. Pascoe, Journ. Ent. 1 (1862) 345; Trans. Ent. Soc. Lond. 3 3 (1866) 288; Gahan, Ann. Mus. Civ. Genoa 2 14 (1895) 48.

Imantocera plumosa Olivier. Pascoe, Proc. Zool. Soc. Lond. (1866) 251; Breuning, Nov. Ent., Suppl. 3 2 (1745) 527.

Imantocera borneotica Breuning, Fol. Zool. Hydrobiol. 10 (1940) 414; Nov. Ent., suppl. 3 2 (1945) 528. New synonymy.

In this species there are three colors in the pubescence on the elytra, the fulvous appearing as rather small, seriate maculæ; the scutellum is fulvous or ochraceous pubescent, broadly margined with white or yellowish-white.

Male.—Robust; black, covered with mottled fuscous, grayish-white and fulvous pubescence. Pronotum with a broad, irregular, pale vitta over lateral tubercles consisting mostly of whitish pubescence with some fulvous and several smaller patches of fuscous pubescence intermingled. Scutellum ochraceous or fulvous pubescent, rather broadly margined with white or yellowish-white. Elytra with fulvous pubescence appearing as small, seriate maculæ; at apex a small, fulvous, oval macula placed obliquely. Beneath fuscous, thinly, sparsely, brown and gray pubescent with scattered, coarse, white hairs; laterally with small, fulvous maculæ, abdomen with double rows on each side. Legs piceous, mottled with fulvous, fuscous, and gray pubescence and with scattered white hairs; femora annulate at apex with fuscous; metatibiæ with a fulvous macula near apex; tarsi and claw segment gray basally. Antennæ piceous, from sixth segment much paler, all segments broadly pale annulate at base.

Head with a few coarse punctures on vertex and base of antennal tubercles. Pronotum slightly elongate; basal sulcus deep; disk with anterior tubercles broad, rounded, with a broad, deep depression between them, the basal tubercles small. Elytra each with an arcuate row of transverse granules on basal quarter, the ridge distinct to middle and with coarse punctures; disk on basal quarter between granulated ridges with small, sparse granules, humeri and disk between ridges more coarsely and closely granulated, remainder of disk punctate, the punctures becoming finer apically. Mesosternum at base with a large, obtuse tubercle. Fifth sternite broadly obtuse at apex. Profemora at extreme base roughly rugose; protibial spur strong with a long robust tooth. Antennæ about one-third longer than body; scape attaining apex of pronotum, finely, densely punctate and with a few feeble rugosities; third segment slightly more than twice length of scape, slightly thickened internally at apex; fourth slightly shorter than third, expanded on apical third and with a long, thick process internally at apex, ventrally with a thick tuft of hairs on the expanded portion; fifth feebly tufted at apex; remaining segments much shorter; eleventh slightly longer than tenth, acuminate at apex.

Female.—More robust than male; pronotum transverse; protibial spur feeble; fifth sternite with apex broadly rounded; antennæ as long or very slightly shorter than body, eleventh segment only very slightly shorter than tenth.

Length 13.5 to 21 millimeters; width 4 to 6.5.

Type locality: East Indes (*plumosa*); Mahakin Riv., Borneo (*borneotica*).

Distribution: Sumatra and Borneo.

Sumatra: ♂, no locality data (Muller); [RNHL]. 10 ♂, 2 ♀, Tandjong Morawa Serdang (*B. Hangen*) [RNHL]. 15 ♂, 8 ♀, Muara Kiawai, June 1915 (*E. Jacobson*) [RNHL]. ♂, ♀, Manna (*M. Knappert*) [RNHL]. ♂, Palembang (*Keil*) [RNHL]. ♀, Sipirok [RNHL]. ♂, Lang Kat (*Dixon*) [RNHL].

Borneo: ♂, 2 ♀, no locality data [MCZ, RNHL]. 2 ♂, Brunei [USNM]. 5 ♂, Sandakan [USNM, RNHL]. ♂, Smitau [RNHL]. ♂, ♀, Ketoengan [RNHL]. 2 ♂, Pontianak [EFG]. 2 ♂, ♀, Bov. Kapoea [RNHL]. 2 ♂, Kinabalu [MCZ]. ♂, Balikpapan [RNHL]. ♂, ♀, Muara Kiawai, April 1915 [RNHL]. 12 ♂, 9 ♀, Mahakkam [RNHL; NRS-Type of *borneotica*].

5. IMANTOCERA PLUMOSA ACMOCEROIDES Thomson Plate 3, fig. 5.

Imantocera acmoceroides Thomson, Syst. Ceramb. (1865) 555.

Male.—Like Sumatran examples but distinct in having the colored markings on pronotum reddish-brown rather than fulvous and the disk more largely fuscous pubescent; and the elytra are heavily fuscous-mottled, so that very little hoary and fulvous pubescence is evident.

Length 16 millimeters; width 5.

Type locality: Malacca.

Distribution: Extreme southeastern Asia.

Siam: 2 ♂, Trong [USNM, CAS].
Malacca: ♂, no locality data [AMNH].

6. IMANTOCERA NIASENSIS DEJONGI subsp. nov. Plate 3, fig. 8.

In the present form, the elytra are covered with pale fulvous pubescence, mottled with fuscous but without any ochraceous markings; the sixth to eleventh antennal segments are entirely pale pubescent; the mesosternum is armed with a tubercle which projects forward rather strongly; and the scutellum uniformly pale fulvous pubescent.

Male.—Robust, black, largely covered with pale fulvous pubescence, mottled with fuscous. Head mostly fuscous, on vertex with sparse, fulvous maculæ, a distinct linear macula on each side. Pronotum strongly fuscous-mottled medially and anteriorly, leaving the fulvous area above the spines and laterobasally nearly free of dark spots. Scutellum uniformly pale fulvous pubescent. Elytra entirely pale fulvous pubescent, with fuscous and glabrous mottling, sometimes irregularly tinged with deeper fulvous; a small pale macula often present before apex. Body beneath fuscous; laterally pale fulvous pubescent, on abdomen forming two rows of maculæ on each side. Legs fuscous, indistinctly banded with fuscous and hoary pubescence. Antennæ fuscous, pale pubescent briefly beyond middle of third segment, on base of fourth, basal three-quarters of fifth, and entirely covering the succeeding segments.

Head impunctate except on antennal tubercles. Pronotum slightly longer than side at base; basal transverse sulcus distinct; disk with a median longitudinal impression and a rather deep fovea before it, the two anterior tubercles distinct, the posterior pair usually not abrupt behind. Elytra each with a single row of granules extending no further than basal third, the ridge almost completely evanescent shortly behind middle, and with a few fine granules near humeri, the punctation fine and sparse, more or less seriate, becoming even finer and sparser posteriorly. Mesosternum with a prominent tubercle, distinctly projecting cephalad. Fifth sternite feebly emarginate at apex. Protibial spur rather long, slender. Antennæ distinctly longer than body; scape just attaining apex of pronotum, rather rugose above; third segment twice length of first, somewhat thickened internally at apex, sparsely punctate above; fourth nearly as long as third, expanded gradually to apical third, then slightly constricted and strongly reexpanded, especially internally where there is a thick process, the plume dense and long, occupying entire apical half of the under surface; fifth as long as first, the rest much shorter.

Female.—Like male, but more robust; pronotum distinctly transverse; protibial spur short, obtuse; fifth sternite longer than third and fourth together, apex broadly retuse; antennæ as long as body, fifth segment distinctly shorter than first.

Length 19 to 23 millimeters; width 6 to 7.2.

Type, allotype, and paratype in Rijksmuseum van Natuurlijke Historie, Leyden.

Type locality: Tappanoely, Sumatra.

The type male, allotype female, and three paratypes are from the type locality. Three additional paratypes are from Solok, Padang, Sumatra. Named for Dr. C. de Jong, of the Leyden Museum, in acknowledgment of numerous favors received.

7. IMANTOCERA NIASENSIS Breuning Plate 3, fig. 7.

Imantocera niasensis Breuning, Festshrift E. Strand (1936) 304; Nov. Ent., Suppl. 3 2 (1945) 528.

Very similar to the foregoing but constantly differing as follows: Elytra with the granules on and near the humeri larger and denser; the antennæ with the plume covering more than the apical half of the fourth segment, i. e., extending proximad of the middle; and the elytra more heavily mottled with fuscous. In addition, the elytral pubescence frequently is whitish or very pale, but this character varies.

Length 14 to 22 millimeters; with 4.5 to 7.4.

Type locality: Nias Island.

Distribution: Nias Island.

Nias: 15 ♂, 12 ♀, no locality data (*J. D. Pasteur*) [RNHL]. 3 ♂, 2 ♀, Dyma, March to May, 1895 (*R. Mitschke*) [USNM, LL]. 2 ♂, Kalim Bungo [USNM]. ♂, 2 ♀, Goenoeng Sitoli [MCZ].

3. IMANTOCERA GRISESCENS sp. nov. Plate 2, fig. 9.

Male.—Robust, fuscous; entirely covered with mottled gray, pale fulvous, and dark brown or fuscous pubescence, the latter in much smaller quantity than the first two. Pronotum with a broad, pale vitta over lateral tubercles. Scutellum fulvous, margined with white, or entirely fulvous or yellowish-white. Elytra with fulvous pubescence arranged in four or five narrow vittæ; at apex a small, pale, oval macula which is oblique. Beneath piceous, grayish-brown pubescent, with coarse, scattered, white hairs, laterally a row of fulvous maculæ, a double row on abdominal sternites. Legs piceous, grayish pubescent, with coarse, scattered, white hairs; femora annulate apically with dark brown; meso- and metatibiæ with a pale macula medially on dorsal side; tarsi paler and with gray and fulvous pubescence. Antennæ piceous, from fifth segment paler; scape thinly brown and gray pubescent; from third all with basal two-thirds gray annulate, apices dark.

Head impunctate except for a few coarse punctures on base of antennal tubercles. Pronotum feebly elongate; apical discal tubercles with a deep, curved sulcus before and behind at middle of pronotum. Elytra at middle of base each with a feebly arcuate, granulate ridge on basal third, the granules being in a single row and somewhat squamose and transverse; the ridge continued to middle or slightly beyond, the granules replaced by coarse punctures; extreme base between ridges with fine, sparse granules, humeri and surface to ridge with coarser granules; remainder of disk with coarse punctures, the punctures becoming slightly finer apically. Mesosternum at base with a very large tubercle which is either right angled or projecting anteriorly. Fifth sternite broadly retuse. Profemora at extreme base roughly rugose; protibial spur moderate, apex blunt; protarsi broadly dilated and heavily fringed. Antennæ about one and one-third times body length; scape attaining apex of pronotum, surface scabrose; third segment slightly more than twice length of scape, shortly produced at apex on inner side; fourth widened beyond middle and strongly produced at apex on inner side, heavily tufted on apical third; eleventh longer than tenth, acuminate apically.

Female.—Like male, but more robust; pronotum transverse; profemora not rugose basally; protibial spur obtuse; protarsi feebly dilated; antennæ as long as or slightly shorter than body; fifth sternite at apex broadly emarginate.

Length 15 to 23 millimeters; width 4.5 to 7.

Type locality: Senggoro Mountains of Res. Passoeroean, Java.

Holotype, allotype, and paratypes in U.S. National Museum.

The type male, allotype female, and two paratypes are from the type locality, where they were collected in 1899 by A. Koller. Additional paratypes are as follows: One female, collected at Palabuam by Fruhstorfer in the National Museum, two females from Malang in the E. F. Gilmour collection; one female from Ardjoeno, in the Leyden Museum; seven specimens from Montes Tenggers, 4,000 ft., in the Museum of Comparative Zoology and the Leyden Museum, and seven others in the last two musea and in the National collection, labelled simply "Java".

Genus PSECTROCERA Pascoe

Psectrocera Pascoe, Journ. Ent. 1 (1862) 345; Thomson Syst. Ceramb. (1864) 382; Pascoe, Trans. Ent. Soc. Lond. 3 3 (1866) 260, 310; Lacordaire, Gen. Col. 9 (1869) 364, 365.

Moderate-sized beetles; elongate-oblong, cylindrical. Head with front transverse, slightly narrowed below, convex; genæ transverse; eye with lower lobe large, broadly ovate, slightly longer than gena; antennal tubercles prominent, subapproximate at base, broadly divergent apically, armed with a short tooth. Pronotum moderately elongate in male, less strongly so in female; sides not constricted medially; sides unarmed; disk feebly transversely rugose medially. Scutellum as wide as long. Elytra wider at base than pronotum, male attenuate apically, female slightly expanded behind middle; apices separately rounded; base with a series of granules along apex of a low crest, rest of disk more or less seriately punctate. Prosternum simple; mesosternum with a large, right angular tubercle. Legs elongate, especially the forelegs, middle ones shortest. Antennæ nearly twice as long as body in male, slightly longer than body in female; scape attaining pronotal apex, robust, clavate, rather finely punctate above; third segment subequal in length to fourth, apices of both segments somewhat dilated, heavily tufted at apices; tufted also (in lesser degrees) on apices of fifth, eighth, ninth, and tenth.

Genotype.—*Gnoma* (?) *plumigera* Westwood, by original designation.

The tufted antennæ and unarmed pronotum will distinguish this genus.

1. PSECTROCERA PLUMIGERA Westwood Plate 3, fig. 10.

Gnoma? plumigera Westwood, Cab. Orient. Ent. (1848) 11, *pl. 5, fig. 3.*
Psectrocera plumosa Pascoe, Trans. Ent. Soc. Lond. 3 3 (1866) 311; Heyme-Taschenberg, Exot. Käfer (1904) 242, *pl. 35, fig. 2.*

Male.—Elongate, rather slender, dark reddish-brown to piceous, dark brown pubescent. Head with five, narrow, pale to deep fulvous vittæ, one medially, very narrow, one on either side of middle, and one behind lower lobe of eye; front margined laterally, and variegate medially with same pubescence. Pronotum with nine vittæ, one medially, white or yellowish-white, one on either side of middle, one laterally and two above procoxæ, the rest of these all pale to deep fulvous. Scutellum densely white or yellowish-white tomentose. Elytra with a broad, common, white or yellowish-white sutural vitta to basal third, which becomes narrower and oblique, then curves to suture behind middle and continues to apex where it is more or less broken and irregular; each disk with several, indistinct, pale to deep fulvous vittæ which are somewhat irregular and sometimes connected. Beneath reddish-brown to piceous, brownish-ochraceous pubescent, laterally narrowly vittate with yellowish-white pubescence; a small, narrower vitta on metasternum laterally. Legs and antennæ reddish-brown, yellowish-brown pubescent, segments broadly pale annulate, only extreme apices darker; from sixth, segments entirely pale.

Head above finely alutaceous; front with coarse, deep punctures at base of antennal tubercles. Pronotum slightly more than one and one-half times as long as wide; apical sulcus narrow, strongly curved medially, basal one feebly curved medially; disk sparsely feebly rugose. Elytra strongly attenuate to apices which are each narrowly rounded; at base each elytron with a feeble, arcuate, elongate ridge studded at its apex with moderate-sized granules (these sometimes squamose), extreme base with a few granules, thence to middle with coarse, rather sparse punctures; beyond the granulate ridge is a row of deep, coarse punctures continued to apical quarter, remainder of apical half with sparse punctures somewhat seriately arranged. Mesosternum at base with a large, rounded tubercle, process subtruncate at apex. Metasternum with a longitudinal sulcus medially on anterior portion. Fifth sternite at apex broadly obtuse. Profemora narrowly rugose ventrally; protibial spur feeble, obtuse; protarsi dilated and fringed. Antennæ one and one-half to nearly twice body length; scape attaining apex of pronotum, very finely densely punctate, with a few larger scattered punctures; third segment slightly more than twice length of scape, heavily tufted on apical third, fourth and fifth less heavily tufted at apex; seventh, ninth, and tenth feebly tufted apically; eleventh longer than tenth, appendiculate at apex.

Female.—In color and markings same as male. Slightly more robust; pronotum feebly elongate; tubercle on mesosternum much smaller; profemora not rugose, protibial spur lacking; protibiæ not fringed; antennæ about one and one-third times body length, fifth segment feebly tufted, not tufted on seventh, ninth, and tenth.

Length 16.5 to 28 millimeters; width 4.5 to 7.

Type locality: Java.

Distribution: Java, Borneo, Sumatra, New Guinea.

New Guinea: ♂, Astrolabe Bay (*Rhode*) [USNM].

Borneo: 2 ♂, no locality data [RNHL]. ♀, Balikpap, July 8, 1912 [RNHL]. ♂, Koetec [*C. Bork*] (RNHL).

Sumatra: ♂, 2 ♀, no locality data [RNHL]. ♂, Muara, Kiawai, June 1945 (*E. Jacobson*) [RNHL]. ♂, Manna (*M. Knappert*) [RNHL].

Java: 7 ♂, 2 ♀, no locality data [RNHL.-♀; MCZ-4♂, ♀; USNM-3♂]. ♂, ♀, Malang, 2nd Mt. (*A. Koller*) [RNML]. 4 ♂, 2 ♀, Preanger (*P. F. Sijthoff*) [RNHL]. 3 ♂, ♀ G. Tangkoeban Prahoe, 4,000–5,000 ft., Preanger, Jan. 10–15, 1935 (*F. C. Drescher*) [LL]. ♂, ♀ Bandong, Preanger; (*Sijthoff*) [RNHL]. 2 ♂, ♀ Teogoe (*L. D. Pasteur*) [RNHL].

Some specimens have the markings entirely white or grayish-white instead of fulvous.

Genus GNOMA Fabricius

Gnoma Fabricius, Syst. Eleuth. **2** (1801) 315; Latreille, Regne Anim. Ins. **3** (1817) 314; ed. 2 **5** (1829) 126; ed. Masson, Ins. **1** (1849) 490; Serville, Enc. Meth. Ins. **10** (1825) 337; Ann. Soc. Ent. France **4** (1835) 71; Castelnau, Hist. Nat. Col. **2** (1840) 480; Blanchard, Hist. Nat. Ins. **2** (1845) 159; Voy. Pole Sud, Zool. **4** (1853) 269; Thomson, Class. Ceramb. (1860) 104; Syst. Ceramb. (1864) 382; Pascoe, Trans. Ent. Soc. Lond. 3 **3** (1866) 311; Lacordaire, Gen. Col. **9** (1869) 366; Schwarzer, Senckenbergiana **8** (1926) 279; Breuning, Nov. Ent., Suppl. 3 **2** (1945) 529.

Moderate to large-sized beetles; elongate-oblong, cylindrical. Head with front transverse, feebly convex, widened below; genæ transverse; eyes with lower lobe large, broadly ovate, slightly longer than gena; antennal tubercles strongly prominent, subapproximate at base, widely divergent above, armed with a short obtuse tooth at apex. Pronotum very elongate in male, less so in female, strongly constricted medially in male, at base wider than at apex; sides unarmed; entire surface multicarinate, in female carinæ often interrupted medially. Scutellum transverse. Elytra wider at base than pronotum, in male gradually attenuate posteriorly; in female slightly expanded behind middle; apices separately narrowly rounded; behind scutellum along suture a broadly triangular impression; disk at base granulate; humeri prominent, more or less right angular, the angle simply rounded. Prosternum simple; mesosternum sometimes tuberculate anteriorly. Legs elongate, especially the forelegs, longer in male, the middle ones shortest in female. Antennæ one and one-half or more times as long as body in male, in female one and one-fourth to one and one-half times body length; scape rather short, attaining pronotal apex, clavate and cicatriced apically, punctate or scabrose above; third segment straight, elongate, longer than fourth.

Genotype.—*Cerambyx longicollis* Fabricius, designated by Thomson, 1864.

Key to species

1. Elytra with a sutural vitta continuing from scutellum to apex; sametimes composed of minute maculæ or briefly interrupted behind middle 2
Elytra with sutural vitta absent or confined to basal half or less 6
2. Elytra with sutural vitta solid 3
Elytra with sutural vitta composed of minute maculæ 5
3. Elytra shining black (Celebes and the Moluccas) .... *agroides*
Elytra covered with brown tomentum 4
4. Elytra with a fine transverse line medially (New Guinea) .... *gelvinka* ♂
Elytra without a transverse line medially (Philippines) .... *suturifera*
5. Elytra at middle with a narrow, transverse fascia of minute maculæ (Celebes and other southern islands) .... *pulverea*
Elytra at middle with a broad, more or less diamond-shaped, common macula, composed of reticular tomentum (Philippines) .... *luzonica*
6. Elytra with a sutural vitta on basal portion 7
Elytra with sutural vitta absent 9
7. Elytra with a narrow, linear fascia medially; pronotal median vitta prominent, of equal width throughout (Philippines and Borneo) .... *vittaticollis*
Elytra with median fascia not linear; pronotal median vitta indistinct, attenuate apically (New Guinea) 8
8. Elytra on apical quarter minutely irrorate with white .... *boisduvali* ♀
Elytra at apex with a small, oblique, white macula .... *affinis* ♀
9. Elytra with a distinct, linear, transverse, median fascia 10
Elytra without a distinct, linear, transverse, median fascia 11
10. Elytral median fascia within a wide brown band; on apical and basal portions of elytra with minute ochraceous reticulations (Philippines) .... *jugalis*
Elytra only with a median, interrupted, white fascia, disk with a metalic reflex (Moluccas and New Guinea) .... *zonaria* ♀
11. Elytra black, shining, without any markings, usually with a metallic reflex (Moluccas and New Guinea) .... *zonaria* ♂

Elytra not so 12
12. Elytra medially with a single, large, white macula (New Guinea) .... *affinis* ♂
Elytra not so 13
13. Elytra covered with mottled brown pubescence, without any pale maculations 14
Elytra with pale markings 15
14. Mesosternal tubercle very prominent, strongly elevated, somewhat recurved at apex (Admiralty Islands) .... *uniformis* ♂
Mesosternal tubercle obtuse, not very prominent (Admiralty Islands) .... *admirala* ♂
15. Elytra brown pubescent, with an indistinct median pale fascia (Admiralty Islands) .... *uniformis* ♀
Elytra not so 16
16. Elytra with a broad area of dense white tomentum on anterior half 17
Elytra without an area of dense white tomentum 18
17. Elytra basal white area in the form of broad, common triangle, with its apex behind scutellum, not intermixed with ochraceous .... *gelvinka* ♀
Elytra basal white area not triangular in shape, behind humeri and at base intermixed with ochraceous .... *admirala* ♀
18. Elytra surface color black, the white pubescence in a form of a median band, widening towards suture, and an area on apical quarter, the band and area made up of fine reticulations .... *boisduvali* ♂
Elytral surface color fuscous or brown, white or pale markings otherwise 19
19. Front devoid of punctures except near antennal tubercles. *sublaevifrons*
Front punctate 20
20. Elytra sparsely sprinkled with minute whistle guttules.............. *thomsoni*
Elytra not so 21
21. Elytra with the maculation finely reticular, rather sparse, nearly white in color, basal granules coarse; rather squamiform; mesosternum with the tubercles placed more cephalad; antennæ in male without a hair pencil; body form very elongate .... *sticticollis*
Elytra with maculation coarse and dense, often fulvous or ochraceous, basal granules moderate, separated, usually not squamiform; body form more robust 22
22. Front more densely punctate; body length small, 13 to 18 millimiters; antennæ in male sparsely fringed beneath to fourth segment, bearing a fine hair pencil on apex of seventh segment .... *gilmouri*
Front rather sparsely punctate; body longer, 13 to 28 millimeters; antennæ in male rather densely fringed beneath to sixth or seventh segment, without trace of hair pencil .... *longicollis*

1. GNOMA ZONARIA Linné. Plate II, figs. 1, 2.

Cerambyx zonarius Linné, Syst. Nat., ed. 10 (1758) 394.
Gnoma zonaria Linné. Schwarzer, Senckenbergiana 8 (1926) 284, *pl. 4, figs. 20, 21;* Breuning, Nov. Ent., Suppl. 3 I (1945) 582.

Cerambyx giraffa Schreibers, Trans. Linn. Soc. Lond. (1801) 198, *pl. 21, fig. 8.*

Gnoma antilope Boisduval, Voy. Astrolabe, Ins. 2 (1835) 508.

Gnoma giraffa Scheibers. Donovan, Ins. New Holl. (1805) *pl. 5, fig. 1; Guérin,* Voy. Coquille Ins., Col. (1831) *pl. 7, fig. 11;* Zool. 2 2 (1838) 135; Pascoe, Trans. Ent. Soc. Lond. 8 3 (1866) 312; Bates, Proc. Zool. Soc. Lond. (1877) 158.

Male.—Slender; entirely black or piceous, rather shining, with a greenish or purplish reflex, covered very sparsely with fine, brown pubescence. Scutellum densely white tomentose. Beneath legs and antennæ with sparse, fine, gray pubescence, which is somewhat denser on tibiæ.

Head above minutely alutaceous, with coarse, deep punctures which are well separated; front as above but the coarse punctures denser on antennal tubercles, forming rugosities. Pronotum about two and one-half times as long as wide; regularly, transversely multicarinulate, at base a few irregular and interrupted at middle. Elytra with sides broadly arcuate, apices each rather narrowly rounded; basal quarter rugosely granulate-punctate, thence to middle with coarse, well-spaced punctures, behind middle punctures finer, obsolete apically. Mesosternum basally with a large, well-elevated, rounded tubercle which is rugose basally, disk of process more or less transversely rugose, apex narrowly rounded; anterior process of metasternum with either a triangular fovea at base or a transverse sulcus; fifth sternite moderately emarginate at apex. Profemora rugose ventrally; protibiae ventrally serrate, spur strong and acute; protarsi dilated and fringed. Antennæ one and three-quarters to two times body length; scape attaining apex of pronotum, surface scabrose; third segment about three times length of scape, scabrose on basal two-thirds, fourth to ninth gradually shorter, tenth suddenly shorter, eleventh much longer than tenth and acuminate at tip; scape and third feebly fimbriate ventrally.

Female.—Body pubescence slightly denser; pronotum with a narrow median vitta, sometimes much interrupted, basal and apical quarters of elytra with fine, sparse, white maculæ, at middle with a narrow, transverse, white fascia with the anterior and posterior edges irregular; sometimes mesosternal side-pieces with a small, white macula; antennal segments from fourth heavily annulate on at least basal halves with gray. More robust; pronotum elongate; fifth sternite subtruncate apically; profemora not rugose, protibiæ lacking spur, protarsi slightly dilated, not fringed; antennæ one and one-third to one and one-half times the length of body; third segment a little over twice length of scape.

Length 15 to 33 millimeters; width 3.7 to 7.

Type locality: "America" (*zonaria*); New Guinea (*antilope*).

Distribution: Moluccas, New Guinea, and Bismarck Archipelago.

Ceram: 7 ♂, 7 ♀, no locality data [MCZ, RNHL, USNM, EFG]. 6 ♂, 3 ♀, Wahaai [MCZ, RNHL]. 10 ♂, 7 ♀, Kairatu, February-March, 1892 [ANSP, USNM].
Amboina: 30 ♂, 15 ♀, [MCZ, RNHL, USNM].
Aru: ♂, 2 ♀, [RNHL].
New Guinea: 5 ♂, 4 ♀, no locality data [MCZ, RNHL].
New Britain: 2 ♀, no locality data [AM].
New Ireland: ♂ [EFG].

1a. GNOMA ZONARIA var. ALBONARIA Breuning

Gnoma zonaria var. *albovaria* Breuning, Nov. Ent., Suppl. 3 **2** (1945) 532.

Breuning states that this form has the "elytra very densely varied with white on basal quarter and on apical quarter."

Type locality: Telesca, New Britain.

The two specimens listed above were typical *zonaria* in all respects; Breuning likewise lists *zonaria* from New Britain. It may be that this "variety" deserves full specific (or full synonymic) status.

2. GNOMA AFFINIS AFFINIS Guéron. Plate 1, figs. 3, 4.

Gnoma longicollis Olivier (non Fabricius), Ent. 67 **4** (1795) 49, *pl. 11, fig. 73;* Boisduval, Voy. Astrolabe, Ins. **2** (1835) 509.
Gnoma affinis Guérin, Voy. Coquille, Zool. Atlas, Ins. (1831) *t. 7, fig. 18;* Texte Zool. 2 **2** (1838) 136; Boisduval, Voy. Astrolabe, Ins. **2** (1835) 539; Schwarzer, Senckenbergiana **8** (1926) 284, *pl. 4, figs. 24, 25;* Breuning, Nov. Ent., Suppl. 3 **2** (1945) 534.
Gnoma ctenostomoides Thomson, Class. Ceramby. (1860) 105; Pascoe, Trans, Ent. Soc. Lond. 3 **3** (1866) 318.

Male.—Rather slender, black, pronotum sometimes piceous, shining, sometimes with a violet reflex. Pronotum on basal fifth with a short, yellowish-white vitta which is strongly narrowed apically. Scutellum densely white tomentose. Elytra at middle with a small, irregular, white macula, which is sometimes broken into several small ones; at apex with a narrow, oblique macula of same color, variable in length and width; base at humerus with a small, white macula. Beneath piceous, thinly, finely, pale gray pubescent; mesosternal side-pieces with dense, white pubescence. Antennæ and legs piceous, thinly, finely, gray pubescent.

Head above finely, alutaceous, with a few, coarse, rather deep punctures on vertex; front same as head above but the punctures more numerous, more shallow and very dense on the bases of the antennal tubercles. Pronotum slightly more than twice as long as wide, regularly, transversely carinate. Elytra gradually attenuate to apices, which are separately, narrowly rounded; basal quarter densely granulate to middle punctate, the punctures just before middle small and scattered, beyond middle the punctures entirely absent. Mesosternal process with a strong, obtuse tubercle at base; fifth sternite at apex broadly retuse. Profemora strongly rugose ventrally; protibiæ serrate ventrally, spine long and acute, feebly arcuate; protarsi dilated and fringed. Antennæ about twice body length; scape attaining apex of pronotum, surface roughly scabrose; third segment nearly thrice length of scape, roughly rugose on basal half, more finely so and densely, finely punctuate on apical half; fourth slightly longer than fifth; eleventh longer than tenth, acuminate at tip.

Female.—Dark, brown pubescent with a stronger violet reflex; head above with an indistinct, irregular, ochraceous vitta on either side of middle, front laterally and with a few maculæ on middle and eyes margined with same color; pronotum with five whitish vittæ, one at middle, one laterally, one above procoxæ, the latter tinged with ochraceous at base; scutellum pale tawny or yellowish-white; elytra with a short, whitish, sutural vitta (narrower at base), which joins a triangular fascia at middle, the fascia much broken and irregular, sometimes only a single, small triangle of whitish pubescence remaining, laterally with minute, white maculæ irregularly placed, at apex with a few more minute, whitish maculæ besides the oblique one; the maculation on sterna ochraceous as well as that laterally on sternites; antennæ broadly annulate with gray; femora and tibiæ dorsally tinged with ochraceous. More robust; pronotum slightly longer than wide, carinæ rather regular; elytra slightly widened behind middle; mesosternal tubercle less strongly produced; fifth sternite broadly emarginate at apex.

Length 14.8 to 26 millimeters; width 2.7 to 5.7.

Type locality: New Guinea.

Distribution: Dutch New Guinea.

Dutch New Guinea: 5 ♂, 2 ♀, no locality data [ANSP, AMNH, RNHL, MCZ]. 5 ♂, 6 ♀, Fakfak [EFG, RNHL]. 8 ♂, ♀, Manokwari [MCZ]. 7 ♂, 7 ♀, Andai [USNM, EFG, RNHL]. 3 ♂, 2 ♀, Aiman, October. 11, 1933 [LL]. ♂, Wandsei [EFG]. 2 ♂, ♀, Wasian, September 15, 1939 [LL]. ♀, Fakar (*Fruhstorfer*) [USNM]. ♂, Doreh 1875 [USNM]. ♀, Geelwink Baai [RNHL]. ♂, ♀, Mar Village, West Vogel kop, November-December (*Mallory*) [AMNH]. 2 ♂, Arfak Mountains [EFG]. 5 ♂, ♀, Sekroe [RHNL]. Salwatti Island: 7 ♂, 6♀, no locality data [RNHL]. Waigeu: ♂, no locality data [MCZ]. Misool: 2 ♂, no locality data [MCZ, RNHL].

3. GNOMA AFFINIS BLANCHARDI Breuning. **Plate 1, figs. 5, 6.**

Gnoma albotessellata Schwarzer [non Boisduval], Senckenbergiana, 8 (1926) 285, *pl. 4, figs. 28, 29.*

Gnoma blanchardi Breuning, Nov. Ent., Suppl. 3 2 (1945) 332.

Male.—Differs from the nymotypic form in having a rather dense, dark brown pubescence above, the median macula of the elytra much larger and with a more pronounced metallic reflex; the elytra are also coarsely punctate to middle. In the female there is a rather distinct, narrow, short, white vitta from humerus, and the median fascia is more solidly white tomentose, less broken into finer maculæ.

Length 9.5 to 23 millimeters; width 3.5 to 6.

Distribution: Eastern New Guinea.

New Guinea: 11 ♂, no locality data [AM, AMNH, MCZ, USNM]. ♂, Bolan Gbg. [MCZ]. ♂, Roon [ANSP]. ♀, Andai [RNHL]. 2 ♂, 3 ♀, Owgarra, (Meek) [EFG]. 2 ♂, 2 ♀, Rossel Island [EFG].

Papua: 7 ♂, 6 ♀, Milne Bay [ANSP, USNM, MCZ, EFG, AM, AMNH]. 3 ♂, 2 ♀, Palmer River, June 7–14, 1936 [AMNH]. ♂, ♀, Fly River, 5 m. below Palmer River, May 23–31, 1936 [AMNH]. 2♂, ♀, Aitape, December 1944, (Enns) [LL]. ♀, Samasi, July 10, 1939 (Wind) [LL]. ♂, Iglubirei, 1890 [USNM]. ♂, 5 ♀, Yule Island [USNM, AM, ANSP]. ♂, Aligaba Creek [USNM]. Dutch New Guinea: ♂, Upper Setekwa River, Snow Mountains, 2,000–3,000 ft. [EFG]. ♂, Aiman, October 11, 1939 [LL].

New Ireland: ♂, Tanga 1933, (Bell) [AM].

Aru Island: 8 ♂, 17 ♀, no locality data [BMNH, USNM, AMNH, ANSP, MCZ, RNHL].

The specimens from the Rossel Islands have the punctures on the basal half of the elytra slightly finer than those of the others included here, but since the difference is so slight it was thought best not to separate them. The males of this subspecies may have the dark brown body tomentum nearly entirely lacking, and be shining as in the nymotype.

4. GNOMA AUSTRALIS Schwarzer

Gnoma australis Schwarzer, Senckenbergiana 8 (1926) 286. *pl. 4, figs. 26, 27;* Breuning, Nov. Ent., Suppl. 3 2 (1945) 534.

"Piceous, shining; front and vertex with a fine median line, finely punctate; antennal tubercles shining and more densely punctate. Antennæ in ♂ more than twice length of body, in ♀ about one and one-half times as long. Scutellum somewhat broader than long, entirely rounded, densely white tomentose. In ♂ pronotum 10 mm. long, elytra 13, in ♀ 7 mm. and elytra 15, hence the ♀ appears relatively broader than ♂, in both sexes the greatest narrowing is behind the middle. Elytra in ♂ only moderately narrowed posteriorly, in ♀ parallel to behind middle; basal quarter granulate, thence to dorsal macula punctate, thence very finely so to apex. Vittæ lacking in both sexes, only at base of pronotum is a *keil*-formed stripe; between shoulder and scutellum at base of elytra in ♂ a spot, in middle of each elytra one, or sometimes several, spots, which in ♂ are small, in ♀ larger, before each apex an oblique, elongate spot, and at apex several (in ♀ more) flecks; in ♀ anterially near and on the suture there are several spots. Beneath and legs shining (the latter finely dusted), covered with scattered granules. Mesepisternum densely white tomentose, in ♀ are several spots on sides of sternites.

"Length ♂ 25 mm.; ♀ 23 mm.

"Patria: Coen district, Cape York.

"Type: ♂, as well as 1 ♂ and 2 ♀ in Museum at Dahlem. Paratypes: ♀ in Senckenberg Mus., 1 ♂ in my coll."

The above is a translation of the original description.

5. GNOMA AGROIDES Thomson

Plate 1, figs. 7, 8.

Gnoma agroides Thomson, Classif. Ceramb. (1860) 106; Pascoe Trans. Ent. Soc. Lond. 3 3 (1866) 312; Schwarzer, Senckenbergiana 8 (1926) 284, *pl 4, figs. 18, 19;* Breuning, Nov. Ent. Suppl. 3 2 (1945) 532.

Gnoma albotessellata Blanchard. Voy. Pole Sud., Zool. 4 (1853) 297, *pl. 17, fig. 8.* [New synonymy].

Gnoma albovittata Thomson, Classif. Ceramb. (1860) 107. [♀]

Gnoma propinqua Pascoe, Trans. Ent. Soc. Lond. 3 3 (1866) 313.

Gnoma pseudosuturalis Schwarzer, Senckenbergiana 8 (1926) 286, *pl. 4, figs. 16, 17.* [New synonymy].

Male.—Rather robust; piceous or black, shining often reflexed with bluish, violet, or greenish, especially on legs and antennæ; sparsely covered with fuscous pubescence. Pronotum with a white tomentose vitta medially, often confined to basal portion. Scutellum entirely white tomentose. Elytra with a sutural white or fulvescent vitta, having entire or irregular margins, running from scutellum to apex; at middle of base each side a short, dark fulvous, arcuate vitta, extending nearly to humerus; often sprinkled with fine, white maculæ, especially on side of disk and on apex, at middle frequently condensed to form a fine, transverse fascia, on densely maculate examples there is a vague dark band behind this fascia. Body beneath and legs more densely black or fuscous pubescent, maculate with white on side-pieces of mesosternum, on sides of metasternum, on metacoxæ, and on apex of first three sternites laterally. Antennæ sparsely hoary pubescent, more densely so on bases of third to fifth segments.

Head nearly impunctate except on antennal tubercles. Pronotum more than twice as long as wide at base; entire disk densely, rather coarsely multicarinate. Elytra arcuately attenuate to apices, which are separately broadly rounded; disk moderately coarsely, rather densely granulate-punctate on basal quarter, thence simply punctate to apex, the punctures gradually becoming minute, posteriorly. Mesosternum with a distinct tubercle anteriorly; fifth sternite boardly truncate at apex. Protibial spur long and acute; metafemora distinctly surpassing elytral apex. Antennæ two and one-quarters times as long as body, not fimbriate beneath; scape attaining pronotal apex, coarsely densely rugose and punctate above; third segment about three times as long as first, rugose above; fourth to seventh subequal, from eight distinctly shorter, the seventh without a hair-pencil.

Female.—Like male, but more robust and much more heavily white-maculate. Head white-maculate above. Pronotum with vitta more distinct, in part double; disk often with reticular hoary markings. Elytra with sutural vitta largely fulvescent, broadly constricted behind middle; at middle a white marking which varies from a mere transverse line or narrow band to a broad area occupying nearly the entire anterior half of the elytra; at apical third often a less distinct fascia, leaving a broad black band between it and the median marking; apical third sprinkled with white to a varying degree. Body beneath maculate with dull fulvous instead of white. Pronotum very slightly longer than wide. Elytra less attenuate. Protibial spur reduced. Fifth sternite longer than third and fourth sternites together, rather narrowly emarginate at apex. Antennæ one-third longer than body.

Length 16 to 34 millimeters; width 4 to 8.

Type locality: Batchian (*agroides* and *albovittata*); Makian (*propinqua*); Magendouw, North Celebes (*pseudosuturalis*); Amboina (*albotessellata*).

Distribution: Moluccas, Celebes, and surrounding islands.

Celebes: 6 ♂, no locality data [AMNH, RNHL]. 2 ♀, Totok [EFG]. ♂, Magendouw [MCZ]. ♂, Toli-Toli [USNM].
Moluccas: 16 ♂, 12 ♀, Ternate [USNM, EFG, ANSP, MCZ RNHL]. 17 ♂, 18 ♀, Halmahera [USNM, MCZ, ANSP, EFG]. 23 ♂, 19 ♀, Morotai [AMNH]. 19 ♂, 16 ♀, Batjan [USNM, ANSP, MCZ, RNHL, EFG]. ♀, Ceram [MCZ]. ♀, Uliasser Isl., Saparua Isl. [ANSP].
Gebeh: 3 ♂, 2 ♀ [MCZ, RNHL].
Key Isl.: ♂ [ANSP].
Salawati Isl.: ♂ [RNHL].
Waigeu Isl.: ♂ [RNHL].
Sangir Isl.: 2 ♂, Taruna, Great Sangir [EFG].
? Sumatra: ♀ [RNHL].
? Philippines: ♀, Palawan [ANSP].

Blanchard's description of *albotessellata* can only apply to the female of *agroides*; it is not a New Guinean species as indicated by Schwarzer.

6. GNOMA ADMIRALA ADMIRALA Dillon and Dillon, sp. nov. Plate 1, figs. 9, 10.

Male.—Rather slender; black. Head and pronotum very sparsely, finely brown pubescent, elytra finely, rather densely brown pubescent, the pubescence on apical half paler and more or less reticulate or mottled (caused in part by punctation); a small macula on humerus pale ochraceous. Scutellum densely white or pale yellowish-white pubescent. Beneath black, thinly, finely, gray pubescent, mesosternal sidepieces densely yellowish-white pubescent, as are the edges of the metacoxæ. Antennæ and legs black, thinly, finely, gray pubescent.

Head above finely alutaceous, vertex with a few coarse, shallow punctures; front with same sculpture as head but punctures at base of antennal tubercles deeper, more numerous. Pronotum at least two times as long as wide, rather regularly, transversely multicarinate; basal and apical sulci feeble. Elytra attenuate gradually to apices which are each narrowly rounded; disk with basal fifth rugosely granulate-punctate, thence to middle coarsely punctate, from middle to apex punctures much finer. Mesosternum at base with a small, obtuse tubercle, process narrowly rounded and with surface transversely rugose. Fifth sternite broadly rounded or feebly retuse. Profemora coarsely rugose ventrally; protibiæ coarsely serrate ventrally, spur strong, acute apically; protarsi strongly dilate and fringed. Antennæ more than twice body length; scape attaining apex of pronotum, surface moderately scabrose; third segment from two to nearly three times length of scape, scabrose on basal two-thirds, coarsely, shallowly punctate on remaining portion; eleventh distinctly longer than tenth; seventh segment not pencilled.

Female.—Pronotum with five indistinct vittæ of thin whitish pubescence, one medially, one laterally, and one above procoxæ; basal half of elytra and apical quarter, white reticulate, less dense near base, leaving a broad brown fascia behind middle; beneath each sternite except fifth apically narrowly margined with white; femora with brownish pubescence dorsally. More robust, pronotum slightly elongate; the carinules of disk near apex tending to be arcuate medially; basal and apical sulci distinct; fifth sternite feebly emarginate apically; profemora obsoletely rugose ventrally; protibiæ obsoletely serrate ventrally, protarsi somewhat dilate, not heavily fringed; protibial spur obsolete; antennæ one and one-half times body length, segments less elongate, gray annulate basally.

Length 17 to 29.5 millimeters; width 4.5 to 8.

Holotype: Male, Admiralty Island, October 15, 1944, (*P. T. Riherd*) [USNM].

Allotype: Female, topotypic [USNM].

Paratypes: Male, topotypic. Male; Manus, Admiralty Island, November 1, 1944, (*Emil Boger*) [both USNM].

7. GNOMA ADMIRALA PALLIDA Dillon and Dillon subsp. nov. Plate 1, figs. 11, 12.

From the typical form, the male differs in having a much paler pubescence on the elytra, more nearly a uniform ochraceous, and much less reticulate in its pattern. In the female the differences are much more marked: the pubescence on the head and pronotum is much denser; the elytral basal half entirely densely white pubescent and much less reticulate; the apical quarter has more numerous and finer reticulations and the brown fascia narrower.

Type locality: Los Negros, Admiralty Islands.

Holotype and allotype in U. S. National Museum.

The holotype male and allotype female were captured by P. T. Riherd at the type locality on January 12, 1945.

8. GNOMA UNIFORMIS Dillon and Dillon, sp. nov. Plate 1, figs. 13, 14.

Resembles *admirala* very closely, but the humeral macula more distinct; the female with only a trace of a median pale fascia; the mesosternal tubercle very prominent, strongly elevated and somewhat recurved at tip.

Male.—Rather slender, black; head and pronotum with extremely sparse, very short, fine gray pubescence; scutellum densely yellowish-white pubescent; elytra with dense, fuscous and deep ochraceous mottled pubescence, the latter pubescence much heavier on apical half; humeri with a bright ochraceous macula. Beneath black, very thinly, finely, gray pubescent; mesosternal sidepieces densely yellowish-white pubescent; metacoxæ and lateral apical margins of sternites narrowly ochraceous pubescent. Legs and antennæ black, thinly, finely, gray pubescent.

Head above minutely alutaceous, vertex with scattered, shallow punctures; front with scattered, coarse punctures, much denser on bases of antennal tubercles. Pronotum more than twice as long as wide; disk regularly, transversely multi-carinulate. Elytra strongly attenuate to apices which are each narrowly rounded; disk on basal sixth with coarse, closely set granules, thence to basal half with coarse punctures, the punctures continued to apex but gradually finer. Mesosternum at base with a strong tubercle which is somewhat recurved at tip. Fifth sternite at apex broadly retuse. Profemora coarsely rugose ventrally; protibiæ serrate ventrally and spur strongly produced; protarsi strongly dilated and fringed. Antennæ twice body length; scape attaining apex of pronotum, surface scabrose; third feebly rugose, nearly three times length of scape; eleventh elongate, accuminate at apex.

Female.—With slightly heavier more ochraceous pubescence on head and pronotum; elytra at middle with a trace of a narrow, median, fulvous fascia and a few very small maculæ scattered over apical half; mesosternal sidepieces ochraceous pubescent. More robust; pronotum feebly transverse; fifth sternite broadly emarginate; (antennæ lacking from fifth); profemora not rugose ventrally; protibiæ not serrate and protibial spur obsolete; protarsi feebly dilated.

Length 18.5 to 24.5 millimeters; width 5.5 to 6.5.

Type locality: Los Negros, Admiralty Islands.

Holotype and allotype in U. S. National Museum.

The holotype female and the allotype male were captured at the type locality on January 12 and February 4, 1945, respectively, by Mr. Riherd.

9. GNOMA GEELVINKA Dillon and Dillon, sp. nov. Plate 1, figs. 15, 16.

Very closely allied to *agroides* but constantly distinct in male having the sutural stripe of elytra narrower, very fine behind middle, a distinct, interrupted, transverse line at middle of elytra, and pronotum without trace of the median vitta. In female the sutural line is merged with the anterior patch of white pubescence, and behind middle is very narrow, failing to reexpand after the post-median black fascia, and the pronotal median vittæ is fulvescent, not whitish and there are fulvous lateral vittæ present. Elytra less densely granulate in both sexes.

Male.—Rather slender; black, sparsely covered with fuscous pubescence. Head and pronotum immaculate. Scutellum largely white or fulvous pubescent. Elytra with a fine, white or fulvous, sutural stripe, becoming sub-linear behind middle, very feebly reëxpanded before apex; each near middle of base with an irregular, fulvous macula; at middle an irregular, broad, white line or narrow fascia, sometimes interrupted, attaining sutural stripe and lateral margin; before apex with a large number of minute, well separated, white maculæ. Beneath as in *agroides* but markings fulvous-white instead of white. Legs and antennæ black, sparsely grayish pubescent.

Head nearly impunctate except on antennal tubercles. Pronotum more than twice as long as broad at base; entire disk densely, rather coarsely multicarinate. Elytra arcuately attenuate to apices, which are separately rounded; disk rather finely and sparsely granulate-punctate on basal quarter, thence simply punctate to apex, the punctures gradually becoming minute apically. Mesosternum with a prominent tubercle anteriorly; fifth sternite feebly emarginate at apex. Protibial spur rather long and acute; metafemora distinctly surpassing elytral apex. Antennæ twice length of body, not fimbriate beneath; scape attaining pronotal apex, coarsely, densely rugose and punctate above; third segment three times as long as first, slightly rugose on basal portion; fourth to seventh gradually shorter, from eighth suddenly shortened, the seventh without a hair pencil.

Female.—Like male but more robust; pronotum with a fulvescent double vitta at middle and a dark fulvous vitta each side; elytra with a common, triangular, white area occupying much of basal half; its posterior margin straight (not arcuate as in similarly-marked specimens of *agroides*, ♀), a fulvescent sutural line thence to apex, not widened apically as in *agroides*, on apical quarter a patch of vermicular, white maculæ, leaving a broad, black band free of maculæ behind middle. Beneath black, heavily fulvous pubescent, especially on pronotum, which is nearly entirely covered, mesosternum and its sidepieces, the sides of metasternum and the metepisternum, and the metacoxæ; on the abdomen are small maculæ on the apex of each sternite laterally. Elytra less attenuate. Protibial spur reduced. Fifth sternite longer than third and fourth together, at apex truncate. Antennæ one-third longer than body.

Length 20 to 24 millimeters; width 5 to 6.5.

Type locality: Jobie Island, Geelvink Bay, New Guinea.

Holotype and allotype: Academy of Natural Sciences, Philadelphia; *No. 8260.*

Paratype in Naturhistoriska Riksmuseum, Stockholm.

10. GNOMA BOISDUVALI Plavilstihikov. Plate 1, figs. 17, 18.

Gnoma girraffa Boisduval [non Schreibers], Voy. Astrolabe, Ins. 2 (1835) 508; Schwarzer, Senckenbergiana 8 (1926) 284, *pl. 4, figs. 22, 23.*

Gnoma boisduvali Plavilstihikov Koleop. Rund 17 (1931) 198; Breuning, Nov. Ent., Suppl. 3 2 (1945) 533.

Male.—Rather slender; piceous to dark reddish-brown, elytra usually darker, sometimes black; head and elytra with rather dense, dark brown pubescence. Front varied with pale gray or pale tawny pubescence. Pronotum medially at base with a short, indistinct, whitish vitta, which tapers apically. Scutellum densely white tomentose. Elytra on basal half and apical quarter reticulately maculate with thin, white pubescence, denser on apex, medially a common area of reticulate maculæ which is more or less diamond-shaped, the anterior angle at suture elongate and forming an irregular sutural vitta to scutellum; each humerus with a densely tomentose, white macula. Beneath piceous or dark reddish-brown, covered with very sparse, fine, grap pubescence; mesosternal sidepieces densely white maculate. Legs and antennæ piceous, with thin, fine, pale gray pubescence.

Head above and front finely alutaceous; the front with scattered, large, shallow punctures which are denser above and on antennal tubercles. Pronotum more than twice as long as wide, disk regularly, transversely carinate. Elytra gradually attenuate to apices which are separately narrowly rounded; basal quarter moderately densely granulate; thence to middle coarsely but not densely punctate, to apex more finely and less densely punctate. Mesosternum anteriorly with a broad obtuse tubercle, apex narrowly rounded; fifth sternite broadly, feebly obcordate at apex. Profemora and protibiæ rugose ventrally, protibial spur strong, protarsi dilated and fringed. Antennæ nearly twice body length; scape reaching to slightly beyond apex of pronotum, surface scabrose; third segment, nearly three times length of scape, scabrose on basal two-thirds; fourth and fifth subequal in length.

Female.—The body pubescence somewhat paler and more dense; head usually with two ochraceous vittæ above joined basally, front densely blotched with orchraceous. Pronotum with median vitta more distinct and usually attaining the apex. Scutellum and basal macula near humeri, ochraceous or whitish; the diamond-shaped macula is more heavily pubescent (this varies from same size as in male to a much larger one). More robust; pronotum only about one-third longer than wide, the carinæ sometimes very irregular; elytra widened behind middle; mesosternal tubercle less strongly produced; fifth sternite emarginate at apex; the protibial spur feeble; profemora and protibiæ not rugose.

Length 11 to 24 millimeters; width 3.3 to 5.6.

Type locality: New Guinea.

Distribution: New Guinea.

New Guinea: 11 ♂, 10 ♀, no locality data [RNS, USNM, RNHL, AMNH, MCZ]. 5 ♂, 10 ♀, Oro Bay, Jan. 1944 (*J. R. Helfer*) [LL]. 18 ♂, 20 ♀, Hollandia [LL, USNM]. 4 ♂, 6 ♀, Aitape, Papua [LL]. ♀, Cromwell Range [LL]. 2 ♂, ♀, Sattelberg [MCZ, USNM]. 2 ♂, 3 ♀, Astrolabe Bay [ANSP]. 7 ♂, 5 ♀, Stephansort, Astrolabe Bay, [ANSP, RNS]. ♂, Nadzat Markham, R. Val. [USNM]. 3 ♂, 2 ♀, Toem [USNM]. 2 ♂, 2 ♀, Finchhaven [USNM]. 4 ♂, ♀, Monumbo [RNHL]. ♀, Alexishalen [RNHL]. 4 ♂, 2 ♀, Lae, December 1944 to January 1945 (*J. G. Brooks*) [A.M.]. 10 ♂, 5 ♀, Mt. Lamington Dist, August 1929 (*C. T. McNamara*) [A.M.]. ♂, Aitape, February 1936 (*A. J. Marshall*) [A.M.].

11. GNOMA LONGICOLLIS LONGICOLLIS Fabricius. Plate 2, fig. 13.

Cerambyx longicollis Fabricius, Mant. Ins. 1 (1787) 135.

Gnoma longicollis Fabricius. Fabricius, Syst. Eleuth 2 (1801) 315; Gmelin, in Linné, Syst. Nat. ed. 13, I, 4 (1790) 1826; Castelnau, Hist. Nat. Col. 2 (1840) 481; Schwarzer, Senckerbergiana 8 (1926) 280, *pl. 4, figs. 1, 2;* Breuning, Nov. Ent., Suppl. 3 2 (1945) 530.

Gnoma confusa Thomson, Syst. Ceramb. (1865) 555. [New synonymy].

Gnoma longitarsus Pascoe, Trans, Ent. Soc. Lond. 3 3 (1866) 314. 314.

Very close to *sticticollis* Thomson, but differs from it in having the pubescent maculæ of the elytra and the scutellum bright or deep fulvous instead of whitish; the granulation on elytra finer and not coalescent; the transverse rugæ of pronotum more distinct; metasternum with a prominent tubercle medially and antennæ not annulate.

Male.—Slender; entirely dark reddish-brown to fuscous, covered with dark brown pubescence. Head above fulvous-brown to fulvous pubescent, often brighter near eyes; front brown, margined with bright fulvous. Pronotum usually without trace of a median vitta but sometimes one is indicated by an indistinct concentration of paler brown pubescence. Scutellum deep fulvous pubescent. Elytra with deep or bright fulvous pubescent maculæ, usually reticulating, sparse or nearly wanting on basal half, forming an indistinct band at middle, and covering the apical third almost entirely and there sometimes forming an oblique, ovate vitta before apex. Body beneath ashy-gray pubescent, with bright yellow vittæ or bands on meso- and metasternal sidepieces, on metosternum laterally, and on sides of apical margins of the abdominal sternites. Legs and antennæ ashy-gray pubescent.

Head above finely punctate between eyes; front rather sparsely, moderately finely punctate, especially between eyes. Pronotum nearly two and one-half times as long as broad at base; disk regularly transversely multicarinate; transverse sulci obsolete. Elytra tapering apically, apices separately, rather narrowly rounded; disk on basal quarter rather finely, not densely granulate, the granules displaced by punctures which gradually diminish in size to apex. Mesosternum with a prominent tubercle medially; fifth sternite not quite as long as third and fourth together, apically emarginate. Protibiæ with spur distinct but small; metafemora surpassing elytral apex. Antennæ more than twice as long as body, beneath sparsely fimbriate on third to sixth segments; scape attaining apex of pronotum, rather coarsely rugosely punctate; third segment nearly four times as long as scape; fourth to seventh segments gradually shorter, the rest much shorter; without trace of a hair pencil.

Female.—Like male, but more robust; pronotum one and two-thirds as long as wide; elytra slightly widened to behind middle; protibial spur reduced; fifth sternite longer than third and fourth together, apex retuse; legs shorter; antennæ one and one-half times as long as body.

Length 13 to 28 millimeters; width 2.5 to 6.

Type locality: East Indies (*longicollis*); Singapore, Sarawak (*longitarsus*); Borneo (*confusa*)

Distribution: Borneo

Borneo: 2 ♂, 2 ♀, no locality data [MCZ, RNHL]. 8 ♂, 6 ♀, Pontanak [RNHL]. 4 ♂, 4 ♀, Brunei [USNM; ANSP]. 3 ♀, Sandakan [USNM]. ♂, Mt. Liang [RNHL]. 3 ♂, 3 ♀, Baram, Sarawak [MCZ]. 4 ♂, 3 ♀, Mahakkam [RNHL].

12. GNOMA LONGICOLLIS DISPERSA Pascoe. Plate 2, fig. 14.

Gnoma dispersa Pascoe, Proc. Zool. Soc. Lond. May (1866) 252; Trans. Ent. Soc. Lond. 3 3 Sept. (1866) 314.

Differs from the typical form from Borneo in the following details: Head above with fulvous pubescence only between eyes; pronotum more densely pubescent; elytra with a considerable amount of fulvous pubescence on humeri and maculation over rest of disk denser, especially on basal half.

Length 20 to 22 millimeters; width 4 to 5.

Type locality: Penang [?].

Distribution: Malay Peninsula.

Malay States: ♂, Malacca [MCZ]. ♂, Perak [ANSP].

13. GNOMA LONGICOLLIS SUMATRENSIS Dillon and Dillon, subsp. nov. Plate 1, fig. 15.

Similar to *l. dispersa* but head usually ochraceous pubescent above; pronotum usually with a vague vitta medially; elytra with maculation usually paler and considerably denser; and maculation of undersurface dull in color or obscure. Front very finely sparsely punctate.

Length 16 to 23 millimeters; width 4 to 5.5.

Type locality: Tandjong, Morawa, Serdang. Sumatra.

Type allotype and paratypes in Rijksmuseum van Natuurlijke Histoire, Leiden.

Described from fifteen specimens from Sumatra; the type male; female allotype from Sipirok; three males and two females from Manna; male from Tapanoeli; two male and two female paratypes from Sumatra; male paratype from Oerbosch in the Leiden Museum; male paratype from Mt. Soom, Tanggamoos, in Lionel Lacey collection; and a female paratype from Lompong in the Academy of Natural Sciences, Philadelphia.

14. GNOMA LONGICOLLIS CASNONIOIDES Thomson.

Gnoma casnonioides Thoms. Classif. Ceramb. (1860) 106.

"Blackish, obsoletely variegate, beneath laterally obsoletely yellow maculate; scutellum yellow. Head obsoletely punctate; scape granulate, rest smooth. Prothorax elongate, narrow, in middle constricted, broader behind; transversely, strongly, and closely sulcate. Scutellum smooth. Elytra elongate, much broader than prothorax and about two times longer than it, anteriorly tuberculate, then strongly and closely punctate; apically smooth, rounded. Body beneath smooth. Legs elongate, here and there coarsely punctate. Length 18 millimeters; width 5. India.

"Close to *G. longicollis* and *G. sticticollis* but differs in prothorax less elongate, elytral sculpturing stronger and more concealed, and legs here and there coarsely punctate." (Translation of the original description).

15. GNOMA GILMOURI Dillon and Dillon, sp. nov. Plate 2, fig. 17.

This form is remarkably close in appearance to *G. longicollis dispersa* (likewise from the Malay Peninsula) but is at once distinct in having a hair pencil on the seventh antennal segment in the male. Other differences are found in the front being more densely, uniformly punctate; elytra with a distinct, oblique, dark fascia behind middle; the smaller body size; the presence of yellow pubescence on pro- and mesosternum and on the procoxæ; the shorter antennæ, and the antennal scape more rugosely punctate.

Male.—Slender; piceous antennæ, legs, and elytra slightly paler; fuscous pubescent. Head above ashy pubescent, mottled with drak brown, ochraceous between eyes and antennæ; front dark brown, margined with fulvous. Pronotum without trace of a median vitta. Scutellum ochraceous. Elytra on apical half densely mottled with fulvous, except for a distinct oblique fascia at apical third which is usually almost entirely devoid of maculæ, basal half sparsely maculate but a little more densely so around humeri. Body beneath, legs, and antennæ ashy-gray pubescent; with bright yellow, linear markings on metasternum laterally, and on side-pieces of meso- and metasternum, and on abdominal sternites; mesosternum and prosternum bright yellow pubescent especially medially.

Head above finely, sparsely punctate between eyes; front moderately finely, rather densely, uniformly punctate. Pronotum twice as long as wide; disk regularly, transversely multicarinate, carinæ often interrupted at middle; apical transverse sulcus obsolete, basal one fine. Elytra slightly attenuate apically, apices separately rounded; disk on basal quarter finely, not densely granulate, thence punctate, the punctures finer towards apex. Mesosternum with a feeble tubercle medially; fifth sternite shorter than third and fourth together, apex emarginate. Protibial spur subobsolete; metafemora attaining elytral apex. Antennæ one and one-half times as long as body, scarcely fringed beneath on third to sixth segments; scape attaining pronotal apex, coarsely, rugosely punctate; third segment nearly four times as long as scape; fourth to seventh gradually shorter, the rest much shortened; seventh segment with a recurved hair pencil at apex.

Female.—Like male, but more robust; pronotum less elongate; elytra often wider behind middle; protibial spur wanting; fifth sternite apically retuse; legs shorter; and antennæ only one-third longer than body.

Length 13 to 18 millimeters; width 3 to 4.5.

Type locality: Perak.

Holotype, allotype, and paratype in collection of E. F. Gilmour.

The type male and allotype female are from the type locality; the male and seven female paratypes are from Res. Benkoelen, Marang.

16. GNOMA STICTICOLLIS Thomson. Plate 2, fig. 16.

Gnoma sticticollis Thomson, Arch. Ent. 1 (1857) 297.

Gnoma subfasciata Thomson, Syst. Ceramb. (1865) 555; Schwarzer, Senckenbergiana 8 (1926) 280, *pl. 4, figs. 3, 4.*

Gnoma raffrayi Thomson, Typi Ceramb. (1878) 70.

Gnoma atomaria Guérin, Breuning, Nov. Ent., Suppl. 3 2 (1945) 530.

Gnoma sticticollis Thomson, Syst. Ceramb. (1865) 555, for which see *G. Thomsoni.*

Male.—Rather slender; entirely dark reddish-brown, elytra a little paler; covered with short, fuscous pubescence. Head above often dingy or pale fulvous-gray; front fulvous, with an indistinct patch of brownish each side, rarely mottled with brown. Pronotum with pubescence a little paler medially but not forming a vitta, on sides more distinctly paler. Scutellum whitish or yellowish. Elytra with whitish, pale yellow, or pale fulvous pubescence irregularly placed on basal quarter and in the form of minute maculæ over rest of disk, the maculæ often vermiculate and coalescent, forming an oblique band at middle and a large patch covering apical third, leaving a band behind middle, and often a similar one before middle, free of maculæ. Body beneath and legs sparsely ashy pubescent, with glabrous punctures; body laterally and femora irregularly tinged and vittate with dingy fulvous or light yellow. Antennæ from base of third segment distinctly paler than body, thinly fuscous pubescent, segments from third broadly but inconspicuously annulate with ashy-gray.

Head above sparsely, finely punctate; front rather sparsely, coarsely punctate, especially between the eyes. Pronotum nearly two and one-half times as long as wide at base; disk regularly transversely multicarinate, transverse sulci obsolete. Elytra tapering apically, apices separately, broadly rounded; disk on basal quarter moderately coarsely, densely granulate, thence less densely punctate, punctures finer apically. Mesosternum medially briefly tuberculate; fifth sternite emarginate at apex. Protibiæ with spur poorly developed. Antennæ more than twice as long as body, fringed beneath on third to sixth segments; scape feebly surpassing pronotal apex, coarsely rugosely punctate; third segment nearly four times as long as scape; fourth to seventh subequal, shorter than third, rest suddenly shorter, eleventh longer than tenth; without trace of a hair pencil.

Female.—Like male, but more robust; pronotum two-fifths longer than wide at base; elytra less tapering; protibial spur lacking; fifth sternite longer, apex broadly emarginate; legs shorter, especially hind ones; antennæ only one and one-half times as long as body, segments gradually diminishing from fourth, except eleventh, which is slightly longer than tenth.

Length 20 to 28 millimeters; width 4 to 6.

Type locality; Celebes, Java (*sticticollis*); Java (*subfasciata*) and (*raffrayi*)

Distribution: Java.

Java: ♂, 2♀, no locality data [RNHL] 22♂, 15♀, Preanger [RNHL, LL–♂]. ♀, Sukabumi [RNHL]. 2♀, Pengalengan [RNHL]. ♀, Mt. Tengger [RNHL]. ♀, Mt. Tjikurai [RNHL]. 2♂, Senggoro Mts. of Res. Pasoeroean [USNM, ANSP]. ♂, Boeloe Lawang, Pasoeroean Res. [ANSP].

17. GNOMA THOMSONI Dillon and Dillon, nom. nov. Plate 3, fig. 1.

Gnoma sticticollis Thomson [non Thomson, 1857], Syst. Ceramb. (1865) 555.

Male.—Rather slender; piceous, very sparsely fuscous pubescent. Head entirely dull ochraceous pubescent; front irregularly mottled with dark brown. Pronotum with a median dull ochraceous vitta feebly indicated at base, on each side with a broader and more distinct one. Scutellum fulvous. Elytra with brown-fulvous pubescence, becoming brighter and denser apically; very sparingly sprinkled with small, irregular, whitish maculæ, often denser on apical half. Body beneath and legs as upper surface, the body laterally and on mesosternum maculate and vittate with yellow. Antennæ piceous, from fourth segment becoming paler, indistinctly annulate with gray on bases of segments beginning with third.

Head above minutely punctate around eyes; front coarsely, rather densely punctate. Pronotum nearly two and one-half times as long as wide at base; disk rather irregularly multicarinate. Elytra arcuately tapering apically; apices separately, rather narrowly rounded; disk on basal quarter moderately densely, rather finely granulate, thence punctate to apex, punctures becoming fine posteriorly. Mesosternum anteriorly tuberculate medially; fifth sternite broadly truncate and feebly emarginate at apex. Protibial spur wanting or obsolete. Antennæ about one-half longer than body, sparsely fimbriate beneath on third to fifth segments and with a few hairs present on underside of sixth; scape scarcely surpassing pronotal apex, coarsely rugosely punctate; third segment three times as long as scape; rest gradually shorter; the seventh segment with a long recurved hair pencil.

Female.— A little more robust than male; pronotum only one and one-half times as long as wide at base; elytra slightly widened to behind middle; fifth sternite more narrowly truncate; and antennæ with segments suddenly shorter after the sixth, the seventh lacking a hair pencil.

Length 13 to 24 millimeters; width 2.8 to 6.

Type locality: Java.

Distribution: Java.

Java: 6♂, 4♀, no locality data [USNM, LL, RNHL, MCZ]. 10♂, 4♀, Senggoro Mts., Pasoeroean Res. [USNM, ANSP]. 3♂, Soekaboemi [USNM, ANSP]. ♂, Boeloe Lawang, Pasoeroean Res. [ANSP]. 2♂, ♀, Tesgoe [RNHL]. ♀, Djampang, Koelon [ANSP]. ♂, Pradjekan [MCZ]. ♂, ♀, Malang [RNHL]. ♀, Toegoe [RNHL].

18. GNOMA ATOMARIA Guérin

Gnoma atomaria Guérin, in Belanger, Voy. Ind. Orient. Zool. (1834) 487, *pl. 2, fig. 6.*

"This species is quite distinct from all other known species by the brown elytra spotted with small, white points. Head larger, ochraceous pubescent. Antennæ nearly two times length of body, first segments black, rest whitish at base. Pronotum elongate, more than twice as long as broad, cylindrical, retracted at middle and broader at base; strongly transversely rugose; at middle and on lateral margins with longitudinal yellow lines, very distinct, beginning at base and disappearing towards middle of length of pronotum. Elytra punctate with brown maroon, darker at base; with small white points arranged in transverse bands, môre numerous at apex. Body beneath blackish, with yellow lines along border of elytra and bordering segments of abdomen. All legs blackish, forelegs largest. Length 15 milimeters; width 4. Coromandel Coast." (A translation of the original description).

This species comes very close to *thomsoni*, but apparently differs in having the white elytral maculæ denser apically and the elytra bordered with yellow lines.

19. GNOMA NICOBARICA Breuning

Gnoma nicobarica Breuning, Festchr. E. Strand 1 (1936) 304; Nov. Ent., Suppl. 3 2 (1945) 529.

"Very elongate, antennæ about one-fourth longer than body (♀), scape short, finely punctate, antennal tubercles moderately high, lower ocular lobe somewhat longer than genæ, front broader than high, rather densely, finely punctate. Pronotum one-third longer than broad, transversely rugose and on basal half finely punctate. Scutellum pentagonal. Elytra very long, at base finely granulate, thence densely punctate, punctures finer apically, obsolete on apical fourth. Black, head (except a small black macula on each side of occiput), scutellum, body beneath, legs and antennæ brown-yellow tomentose; pronotum and elytra brown tomentose and densely brown-yellow tomentose, apical halves of third and tenth antennal segments and middle part of eleventh brown tomentose. Length 23 to 26 millimeters. Type 1 ♀ from Nicobars in Brit. Mus."

The above is a translation of the original description.

20. GNOMA SUBLAEVIFRONS Schwarzer. Plate 2, fig. 18.

Gnoma sublævifrons Schwarzer, Senckenbergiana 8 (1926) 285, *pl. 4, fig. 7.*

Gnoma longicollis Breuning [non Fab.], Nov. Ent., Suppl. 3 2 (1945) 530.

Male.—Rather slender; piceous; head and pronotum thinly, elytra more densely covered with irregular, tawny pubescence. Beneath piceous, abdomen dark chestnut, thinly grayish-yellow pubescent. Legs and antennæ dark reddish-brown, or piceous, with thin, fine gray pubescence.

Head above finely alutaceous; front with a few coarse punctures at base of antennal tubercles. Pronotum nearly twice as long as wide; disk transversely carinulate at apex somewhat irregular. Elytra attenuate to apices, which are separately, narrowly rounded; basal quarter rather coarsely granulate, the granules separate, thence to behind middle coarsely, densely punctate, at apical quarter the punctures finer. Mesosternum with a median ridge, not a distinct tubercle; fifth sternite broadly retuse at apex. Profemora not rugose; protibiæ not serrate, the spur obtuse; protarsi heavily fringed. Antennæ nearly twice body length; scape rugorsely punctate; third segment about three and one-half times length of scape, punctate; fourth longer than fifth; seventh not pencilled; eleventh elongate; feebly fimbriate on third and fourth segments ventrally.

Length 23 millimeters; width 5.2.

Type locality: Nias.

Distribution: Nias.

Nias: ♂, Kalim Bungo, Central Nias, July-November 1894 (*R. Mitschke*) [ANSP].

This specimen lacked the "indication of the band" which is slightly post-median, as Schwarzer describes the type.

21. GNOMA JUGALIS MERIDIONALIS Schwarzer. Plate 2, fig. 5.

Gnoma jugalis Schwarzer [non Newman], Senckenbergiana 8 (1926) 281, *pl. 4, figs. 8, 9.*

Gnoma jugalis meridionalis Schwarzer, Senckenbergiana 9 (1929) 372; Breuning, Nov. Ent., Suppl. 3 2 (1945) 531.

Easily distinguished from many of the fasciate groups by the elytra having a very narrow, distinct, white fascia at middle, the remaining surface irrorate (sometimes more reticulate) with fulvous to ochraceous pubescence.

Male.—Rather slender; fuscous, dark brown pubescent, denser on elytra. Head above with indistinct patches of grayish, front rather heavily mottled with ochraceous. Pronotum thinly, finely, gray pubescent, pubescene sometimes denser medially to form an indistinct vitta; laterally and above procoxæ an ochraceous vitta, the former not reaching beyond middle, sometimes both grayish. Scutellum ochraceous. Elytra with basal and apical two-fifths rather densely ochraceous reticulate, the reticulations becoming white near middle, at middle with a narrow, white fascia, which is very irregular on its anterior border. Beneath piceous or fuscous, laterally broadly, densely ochraceous, medially finely gray pubescent; sternites (except fifth which has only one) each with a double row of small, dark maculæ. Legs piceous, thinly, finely, gray pubescent. Antennæ piceous, gray pubescent, apices dark.

Head above finely alutaceous, vertex with a few coarse, deep punctures; front with a few scattered, coarse, shallow punctures, those near antennal tubercles deeper and more numerous.

Pronotum one and one-half times long as wide, regularly, transversely multicarinate. Elytra less strongly attenuate than in other species of this group; apices narrowly rounded; basal quarter moderately granulate, the granules broad, somewhat squamose, remainder of disk punctate, punctures well spaced, finer apically. Mesosternum basally with a large, rounded tubercle, process feebly, transversely rugose, apex narrowly rounded. Fifth sternite at apex broadly retuse. Profemora ventrally feebly, transversely rugose on basal half; protibia ventrally not serrate, spur obtuse and feeble; protarsi dilated and fringed. Antennæ about one and one-half times body length; scape reaching slightly beyond apex of pronotum, with moderate-sized punctures which are well-spaced; third segment two and one-half times the length of scape; eleventh segment longer than tenth, aciculate at apex; seventh segment pencilled.

Female.—More robust; color and markings as in male; pronotum less elongate, carinæ less regular; fifth sternite broadly emarginate; profemora barely rugose ventrally; protibial spur lacking; protarsi only feebly dilate.

Length 17 to 20 millimeters; width 4.6 to 5.7.

Type locality: Surigao, Mindanao, Philippines.

Philippines: 2♀, Davao, Mindanao (*Platen*) [ANSP]. 4♂, 2♀, Butuan, Mindanao (*Baker*); [USNM]. ♂, 2♂, Surigao, Mindanao [USNM]. ♂; Davao, Mindanao [USNM].

22. GNOMA JUGALIS SAMAR Dillon and Dillon, subsp. nov. Plate 2, fig. 6.

Differs from the nymotypic form in having two irregular, ochraceous vittæ on head above, the median pronotal vittæ distinct and ochraceous; the white reticulations near middle on elytra absent or nearly so; the brown fascia behind median, white one, wider.

Length 17.3 to 22 millimeters; width 4.5 to 5.5.

Holotype: Male, Samar Island (*Baker*) [USNM].

Allotype: Female, topotypic [USNM].

Paratypes: Three males, topotypic [USNM].

23. GNOMA JUGALIS JUGALIS Newman

Gnoma jugalis Newman, Entomologist 1 (1842) 299; Schwarzer, Senckenbergiana 9 (1929) 370, *fig. 24;* Breuning, Nov. Ent., Suppl. 3 2 (1945) 531.

According to Schwarzer, the typical race differs in having the transverse white fascia in the middle of the dark brown fascia, while in *meridionalis* it is behind the dark band. This does not hold true in the specimens at hand, but, as no Luzon representatives were encountered, it is impossible to decide whether there are valid differences between these two supposed races.

24. GNOMA LUZONICA LUZONICA Erickson Plate 2, fig. 18.

Gnoma luzonicum Erickson, Nova Acta Acad. Nat. Curiosum **16** Suppl. 7 (1834) 268, *pl. 39, fig. 8;* Schwarzer, Senckenbergiana **8** (1926) 281, *pl. 4, figs. 10, 11;* Breuning, Nov. Ent., Suppl. 3 **2** (1945) 531.

Male.—Rather slender; piceous or dark brown, head and pronotum thinly, elytra densely covered with dark brown pubescence. Head above with an arcuate vitta of from pale tawny to deep tawny pubescence, the vittæ joined on occiput and on vertex, usually there are several small oblique vittæ from the interior margin of each of the large vittæ which meet at middle of head; front irregularly marked and lower lobe of eye margined with tawny; a narrow vitta behind lower lobe of eye, bifurcated towards base. Pronotum with an indistinct, pale tawny vitta medially, another vitta laterally (in line with lateral vitta on head) indistinct and of same color as median vitta or of the color of vittæ on head, entire surface of disk variegated with pale tawny. Scutellum densely, pale tawny pubescent. Elytra with reticulated patches of pale tawny which are denser at base and apex and form a common diamond-shaped macula at middle and a rather irregular, sutural vitta. Beneath dark brown or piceous, thinly, finely, gray pubescent; mesosternal sidepieces, metepimera, metasternum laterally, and sternites laterally and apically, dark tawny pubescent. Legs dark brown or piceous, tibiæ slightly paler; scape piceous, remaining segments slightly paler; scape, basal two-thirds of third, and remaining segments gray annulate.

Head above finely alutaceous, with a few well-spaced, coarse punctures; front with few, very shallow, coarse punctures, except at base of antennal tubercles where they become deeper, larger, and closer, forming rugosities. Pronotum not quite twice as long as wide, disk regularly, transversely multicarinate. Elytra with sides broadly arcuate, gradually attenuate apically; basal quarter finely, moderately densely granulate or granulate-punctate, thence to middle coarsely, rather sparsely punctate, finer apically; apices each narrowly rounded. Mesosternum with a small but distinct tubercle anteriorly; the process narrowly rounded apically; fifth sternite broadly truncate at apex. Profemora serrate ventrally; protibial spur strong; protarsi densely fringed. Antennæ at least twice body length, scape reaching slightly beyond apex of pronotum, surface finely, densely punctate with coarse, shallow punctures interspersed;

third segment nearly three times length of scape, feebly rugose; fourth, fifth, sixth and seventh gradually shorter, seventh pencilled at apex, from eighth suddenly shorter, except eleventh which is slightly longer than tenth; feebly fimbriate ventrally on scape and third and fourth segments.

Female.—More robush; elytra nearly parallel to behind middle, then arcuate to apices; pronotum with carinæ less regular, sometimes broken medially; mesosternum less strongly tubercled anteriorly; fifth sternite feebly emarginate apically; profemora not serrate ventrally; protibial spur feeble; protarsi not fringed; antennæ one and one-half times body length; third segment only two and one-half times as long as scape; seventh segment not pencilled; the bases of the segments from third more heavily gray pubescent.

Length 14.5 to 23 millimeters; width 4.3 to 6.

Type locality: Luzon.

Distribution: Philippine Islands.

No locality data: ♂, ♀ [MCZ].

Luzon: ♂; no locality data [MCZ]. ♂, North Luzon (EFG). ♀, Bayombong [MCZ]. 20 ♂, 20 ♀, Mt. Makiling, May to October (*Baker, Hadden*) [USNM, CAS]. 2 ♂, Mt. Isarog [MCZ]. ♂, Bangui, Ilocos, November 1923 (*McGregor*) USNM]. 4 ♂, 2 ♀, Los Baños (*Baker, Hadden*) (USNM, CAS]. ♂, Mt. Banahao, Laguna (*McGregor*) [CAS]. ♂, Mt. Maranggoy, Zambales (*McGregor*) [CAS]. ♀, Mt. Triman [CAS]. ♂, Mt. Dimatabing (*McGregor*) [CAS]. 2 ♂, Quezon Park, Tayabas, May 16, 1931 [CAS]. 3 ♂, 5 ♀, Iriga, Camarines Sur, June, August (*Caneda*) [CAS].

Sibuyan Island: 8 ♂, 6 ♀ [USNM, CAS].

Mindanao: ♂, Kabasalan, Zamboanga, May 1, 1932 (*Muzzall*) [CAS].

25. GNOMA LUZONICA INSULANA Schwarzer Plate 2, fig. 9.

Gnoma insulana Schwarzer, Senckenbergiana 8 (1926) 285, *pl. 4, figs. 12, 13.*

Gnoma luzonicum transiens Kriesche, Ent. Blätt, 32 (1936) 69.

Differs from the nymotypic form in having the pattern pubescence of upper surface entirely white; the diamond-shaped macula at middle of elytra more transverse, becoming fasciate at lateral angles; elytra with less of the reticulating maculæ.

Length 16 to 28.5 millimeters; width 4.5 to 6.5.

Type locality: Biliran, Leyte, P. I. (*insulana*); Santa Cruz, Leyte (*transiens*).

Distribution: Leyte, Mindanao, and Samar Islands.

Philippines: ♂, no locality data [MCZ]. ♀, Mindanao [EFG].
3 ♂, 4 ♀, Samar Island (*Baker, McGregor*) [USNM].

26. GNOMA LUZONICA BILARAS Dillon and Dillon subsp. nov. Plate 2, fig. 10.

Differs from the other two subspecies in the following ways: From *l. luzonica* in having the color of the pattern pubescence dirty white and in lacking the common diamond shaped macula at middle. From *l. insulana* it differs in having the fascia broadly separated from suture, narrower, and less irregular in outline; fine maculation of sides greatly reduced.

Length 16 millimeters; width 4.5.

Type locality: Bilar, Bohol Island.

Type allotype, and paratype in U. S. National Museum.

The female holotype and paratype were collected at the type locality September, 1932, by McGregor. The male allotype was taken at Biliran Island, by Baker.

27. GNOMA SUTURIFERA SUTURIFERA Schwarzer. Plate 2, fig. 11.

Gnoma suturifera Schwarzer, Senckenbergiana 9 (1929) 370, *fig. 23*; Breuning, Nov. Ent., Suppl. 3 2 (1945) 582.

Resembles *G. luzonica* but has a very distinct sutural vitta which is whitish with lateral margins of ochraceous, it also lacks the diamond-shaped median macula of the elytra.

Male.—Rather slender; black or piceous, dark brown pubescent. Head above with a narrow, arcuate, ochraceous vitta on either side of middle, inner margin irregular, converging on occiput and at vertex; front irregularly blotched with pubescence of the same color. Pronotum with five narrow vittæ of yellowish-white pubescence, on median, one lateral, one above procoxæ (this sometimes slightly darker). Scutellum white or pale ochraceous pubescent. Elytra with a narrow, common, sutural vitta of whitish or yellowish-white pubescence, the outer margin irregular and narrowly ochraceous; the lateral margins of disk, base, and apex with ochreous reticulate markings. Beneath piceous, thinly clothed with fine, pale gray pubescence, with a wide, ochreous, lateral vitta from pronotum to tip of abdomen, an irregular macula of same color laterally on metasternum, and apex of sternites narrowly margined with same; sternites each with a double row of dark maculæ laterally (sometimes the inner row indistinct). Antennæ and legs piceous; legs clothed with dense, fine, gray pubescence; antennæ with basal two-thirds gray pubescent.

Head above finely alutaceous, with a few, coarse, deep punctures, especially medially; front finely alutaceous, with scattered, very shallow, coarse punctures, the bases of the antennal tubercles densely, coarsely punctate. Pronotum not quite twice as long as wide; disk rather regularly, transversely carinate, the carinæ apically and basally somewhat interrupted medially. Elytra gradually attenuate to apices, which are separately, narrowly rounded; disk on basal quarter moderately densely granulate-punctate, coarsely punctate to middle, thence to apex punctures finer and less dense. Mesosternum basally with a large, obtuse tubercle, the process feebly elevated medially, the apex narrowly rounded; fifth sternite broadly retuse apically. Profemora coarsely rugose ventrally; protibial spur strong, protibiæ dilated and fringed. Antennæ about one and one-half to one and three-quarters times body length; scape attaining apex of pronotum, surface moderately rugosely-punctate; third segment nearly three times longer than scape, rugose along nearly its entire length; seventh segment pencilled at apex.

Female.—Antennæ more heavily gray annulate; more robust; elytra slightly widened behind middle; pronotum with carinæ less numerous and less sharply defined; fifth sternite broadly emarginate apically; profemora not rugose ventrally; protibial spur almost entirely lacking; protarsi not dilated and fringed. Antennæ about one and one-third body length; not pencilled on seventh segment.

Length 17.5 to 22 millimeters: width 5 to 5.6.

Type locality: Cuernos Mountains, Negros, Philippine Islands.

Distribution: Philippine.

Philippines: 4 ♂, 2 ♀, Cuernos Mountains, Negros [USNM]. 2 ♂, N. W. Panay (*Baker*) [USNM].

28. GNOMA SUTURIFERA FASCIATA Dillon and Dillon, subsp. nov. Plate 2, fig. 12.

Female.—Distinct from the nymotype in having on the elytra a distinct transverse median whitish line, running from sutural vitta entirely across disk, the fine maculæ on the sides of the disk are whitish or pale fulvous, and the sutural stripe is much interrupted on apical half.

Length 18 millimeters; width 5.

Holotype: ♀, no locality data (*L. Dorhn*) [RNHL].

29. GNOMA PULVEREA PULVEREA Pascoe Plate 2, fig. 1.

Gnoma pulverea Pascoe, Trans. Ent. Soc. Lond. 3 3 (1866) 314; Schwarzer, Senckenbergiana 8 (1926) 284, *pl. 4, figs. 14, 15*; Breuning, Nov. Ent., Suppl. 3 (1945) 583.

Male.—Rather slender; fuscous or black, usually with a bluish or purplish reflex, covered with fine, dark brown pubescence, denser on elytra. Head above with an indistinct, irregular macula of grayish or pale tawny pubescence; front irregularly mottled with same pubescence. Pronotum with five indistinct, grayish-yellow, thinly pubescent vittæ, one media, widest, one on each side, and one above each procoxa. Scutellum and a large macula at base near humeri of elytra, ochraceous or fulvous; sutural vitta very much broken into small maculæ of yellowish-gray pubescence, at middle a vague fascia of small maculæ of same pubescence, base and apex with small scattered maculæ of yellowish-gray. Beneath fuscous, densely yellowish or yellowish-gray pubescent, and with fulvous or ochraceous markings as follows: maculæ on mesosternal sidepieces, metepisternum, metasternum laterally and sternites laterally. Antennæ and legs piceous, thinly, finely gray pubescent, the pubescence denser on legs.

Head above minutely alutaceous, front as head above but with a few coarse punctures on base of antennal tubercles. Pronotum twice as long as wide, disk regularly transversely multicarinate. Elytra attenuate to apices which are each narrowly rounded; basal quarter granulate-punctate, the granules poorly defined, thence to middle coarsely punctate, punctures from middle to apex finer but not less dense. Mesosternum at base with a small, round tubercle, the base of which is rugose; at base of anterior metasternal process a small but wide, transverse sulcus (this sometimes nearly a triangular fovea); fifth sternite at apex broadly retuse. Profemora feebly rugose ventrally on basal half; protibial spur short, blunt; protarsi dilated and fringed. Antennæ nearly twice body length; scape reaching slightly beyond apex of pronotum, surface coarsely, rugosely punctate or sometimes scabrose; third segment nearly three times length of scape, finely densely punctate with scattered, coarse punctures especially on basal half; eleventh longer than tenth, aciculate at apex.

Female.—Color as in male, but somewhat more pubescent; antennæ gray annulate basally; pronotum slightly longer than wide; fifth sternite emarginate at apex; antennæ about one and one-third to one and one-half times body length; profemora with only a few feeble rugosities basally; protibial spur feeble; protarsi scarcely dilated.

Length 15 to 22.5 millimeters; width 3.5 to 6.

Type locality: Macassar, Celebes.

Distribution: Celebes.

Celebes: ♂, ♀, no locality data [MCZ]. 3 ♂, 3 ♀, Tjamba [EFG, [RNHL]. ♀, Bua-Kraeng (*Fruhstorfer*) [ANSP]. ♂, Macassar [RNHL]. ♂, Samanga (*Fruhstorfer*) [ANSP].

30. GNOMA PULVEREA XULLA Dillon and Dillon, subsp. nov. **Plate 2, fig. 3.**

From the nymotypic form this one differs in having the macular pubescence entirely fulvous, and maculæ more numerous and not confined to base and apex, the median fascia distinct, and sutural vitta much broader.

Type locality: Xulla-Besi, Malay Archipelago.

Holotype: Academy of Natural Sciences, Philadelphia. *No. 8259.*

The male type was collected by Doherty.

31. GNOMA PULVEREA LOMBOKIA Dillon and Dillon, subsp. nov. Plate 2, fig. 2.

From *P. xulla* it differs in having the sutural mascular vitta much broader and more broken, the median fascia is broader and composed of many maculæ; the macular pubescence and that of the scutellum is yellowish-white instead of fulvous. The protibial spur is much larger and the profemora ventrally rugose along their full length.

Type locality: Hombok, Sunda Island.

Type: Academy of Natural Science, Philadelphia, *No. 8258.*

The male holotype was collected in April at an elevation of 2,000 ft. by H. Fruhstorfer.

32. GNOMA PULVEREA SANGIRIA Dillon and Dillon, subsp. nov. Plate 2, fig. 4.

Differs from nymotypic form in having the macular color ochraceous, the sutural vitta entire, lateral edges only irregular, the median fascia more distinct and maculæ on apical quarter much more numerous.

Type locality: Taroena, Sarigir.

Type: In the collection of E. F. Gilmour.

The female holotype was taken by Mr. Doherty between March and April at an elevation of 2,000 ft.

33. GNOMA CRUCIATA Kirsch

Gnoma cruciata Kirsch, Mitteil. Zool. Mus. Dresden 2 (1877) 158.

"One of the smaller species, from the known ones of which it is easily distinguished by the coloring and maculation. Dark brown, on head nearly black, a small spot behind eye, antennal tubercles on inner side, and a line from inner edge of each eye to base, sparsely gray pubescent. Pronotum one and one-half times as long as wide, transversely rugose, before base and behind anterior margin somewhat constricted, on median line densely, on a line below sides thinly, whitish-gray pubescent. Scutellum and elytra with suture, a quite narrow, sharply defined crossband close to middle, and a spot mesad to the humeral tubercle, densely white tomentose. Elytra twice as long as pronotum, on base punctate, punctures toward middle sparser and finer, behind cross-band quite free of punctures. On underside finely gray pubescent, the meseprimera and mesepisterna more densely whitish pubescent. Length 16 millimeters; width 4½. Mysore."

From the above translation of the original description it is apparent that *cruciata* is closely related to *vittaticollis* and, in fact, the latter may eventually have to be placed as a subspecies of the former.

34. GNOMA VITTATICOLLIS Aurivillius **Plate 2, fig. 7.**

Gnoma vittaticollis Aurivillius, Ark. Zool. 25 15 (1923) 23, *fig. 127;* Schwarzer Senckenbergiana 9 (1929) 372, *figs. 25, 26;* Breuning, Nov. Ent., Suppl. 3 2 (1945) 531.

Male.—Slender; fuscous, elytra sometimes slightly paler; entirely finely brown pubescent, denser on elytra. Head above with a median vitta, a vitta behind eye and front, yellow or yellowish-white. Pronotum with five vittæ of same color, one medially, one laterally and one above procoxæ. Scutellum entirely yellow or yellowish-white tomentose. Elytra with a common sutural vitta to middle, a narrow fascia at middle and reticulate maculæ on basal and apical quarters of same color pubescence as pronotum and head. Beneath fuscous or dark reddish-brown with thin, fine, gray pubescence, a macula on mesosternal sidepieces, metasternum laterally, mesepistera and a broad vitta laterally on sternites of yellowish pubescence, a transverse macula of dark brown on base of each sternite laterally. Legs fuscous or dark reddish-brown, tibiæ somewhat paler; thinly gray pubescent. Antennæ dark reddish-brown, third segment with basal two-thirds, fourth and remaining segments pale gray annulate.

Head above finely alutaceous; front as head above and with coarse, scattered punctures, these more numerous and deeper on bases of antennal tubercles. Pronotum slightly more than twice as long as wide; disk transversely multicarinate, the carinæ of apex less regular and inclined to curve medially. Elytra with sides broadly arcuate, attenuate apically; apices each narrowly rounded; disk with basal quarter granulate-punctate, the granules slightly squamiform; thence to middle coarsely, moderately closely punctate, to apex punctures finer. Mesosternum with large, elongate, rounded tubercle at middle of process, apex narrowly rounded; apex of fifth sternite emarginate. Profemora not rugose; protibiæ not serrate, spur feeble. Antennæ about twice body length; scape attaining pronotal apex, surface finely densely punctate, with coarser, punctures interspersed; third segment two and one-half to four times length of scape, finely densely punctate; seventh pencilled at apex; eleventh longer than tenth, aciculate at apex.

Female.—Identical to male in coloring; more robust; pronotum slightly longer than wide, with a distinct curved sulcus at apical quarter; fifth sternite broadly arcuate at apex; antennæ about one and one-half times body length, seventh segment not pencilled; protibiæ lacking spur.

Length 9 to 24 millimeters; width 3.5 to 7.

Type locality: S. W. Borneo: Pengaron.

Type in Naturhistoriska Riksmuseum, Stockholm.

Distribution: Borneo, Philippines.

Borneo: 2 ♀, no locality data [RNS–allotype and paratype] ♂; Pengaron, Martopoera, S. W. Borneo [RNS–type]. ♂, Pontianak (*F. Muir*) [USNM]. ♂, Brunei, N. Borneo (*Waterstradt*) [ANSP–Paratype].

Philippines: ♂, Baguio (*G. G. Haslam*) [USNM].

The Philippine specimen differs in having the elytral sutural vitta and the median fascia narrower, the reticulate maculae at apex and base are fewer, and there is a tendency for a short vitta at suture to appear apically. Because there is only one specimen, no attempt is made to distinguish subspecies.

ILLUSTRATIONS

PLATE 1

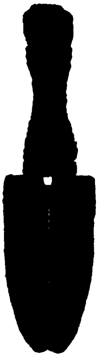
FIGS. 1, 2. G. *zonaria* Linn. ♂, ♀. X 2.5
3, 4. G. *affinis Guérin*. ♂, ♀. X 3
5, 6. G. *Affinis blanchardi* Breuning ♂, ♀. X 3
7, 8. G. *agroides* Thomson. ♂, ♀. X 2.2
9, 10. G. *admirala admirala* sp. nov. ♂, ♀. X 2.4
11, 12. G. *admirala pallida* subsp. nov. ♂, ♀. X 2.4
13, 14. G. *uniformis* sp. nov. ♂, ♀. X 2.8
15, 16. G. *gelvinka* sp. nov. ♂, ♀. X 2.6
17, 18. G. *boisduvali* Plavil. ♂, ♀. X 2.8

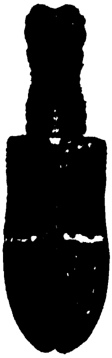
PLATE 2

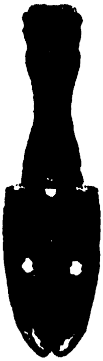
FIG. 1. G. *pulverea pulverea* Pascoe. X 2.6
2. G. *pulverea lombokia* subsp. nov. X 2.6
3. G. *pulverea xulla* subsp. nov. X 2.6
4. G. *pulverea sangirea* subsp. nov. ♀. X 2.6
5. G. *jugalis meridionalis* Schwarzer. X 2.8
6. G. *jugalis samar* subsp. nov. 2.8
7. G. *vittaticollis* Aurivillius. X 2.5
8. G. *luzonica luzonica* Erichon. X 3
9. G. *luzonica insulana* Schwarzer. X 3
10. G. *luzonica bilaris* subsp. nov. X 3.3
11. G. *suturifera suturifera* Schwarzer. X 3
12. G. *suturifera fasciata* subsp. nov. X 3
13. G. *longicollis longicollis* Fabricius. X 2.5
14. G. *longicollis dispersa Pascoe.* X 2.5
15. G. *longicollis sumatrensis* subsp. nov. X 2.8
16. G. *sticticollis* Thomson. X 2.4
17. G. *gilmouri* sp. nov. X 3.2
18. G. *Sublævifrons* Schwarzer. X 2.6

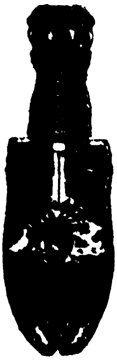
PLATE 3

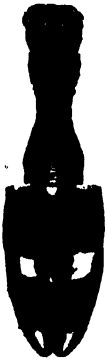
FIG. 1. *Gnoma thomsoni* sp. nov. X 2.8
2. *Imantocera penicillata* Hope. X 3.2
3. *I. sumbavana* Breuning, X 3
4. *I. vicina* Gahan. X 3.3
5. *I. plumosa acmoceroides* Thomson. X 3.4
6. *I. plumosa plumosa* Olivier. X 3.2
7. *I. niasensis niasensis* Breuning. X 3
8. *I. niasensis dejongi* subsp. nov. X 2.8
9. *I. grisescens* sp. nov. X 3
10. *Psectrocera plumigera* Westwood. X 3

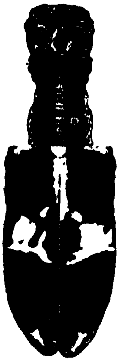


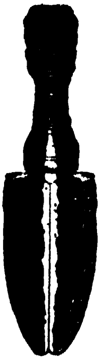












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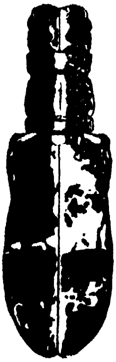

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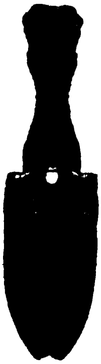

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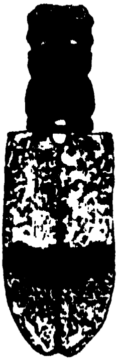

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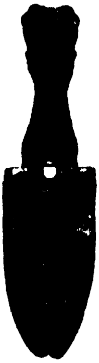

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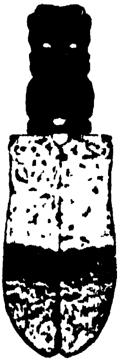

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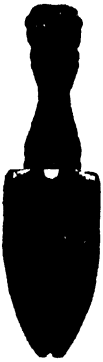

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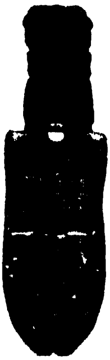

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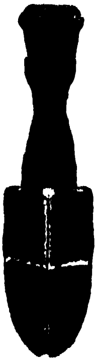

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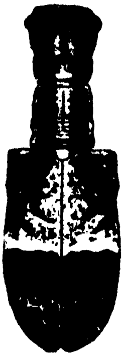

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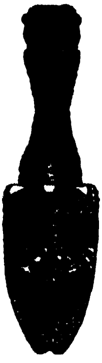

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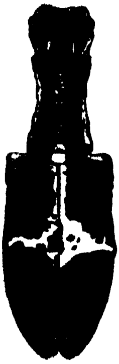

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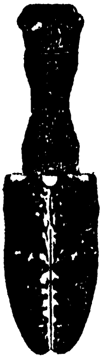
PLATE 1.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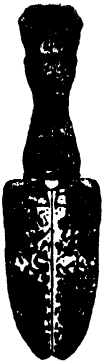
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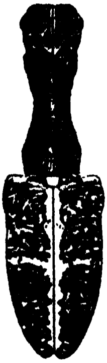
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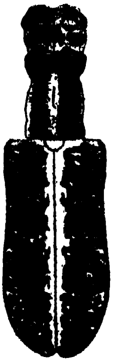
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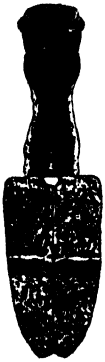
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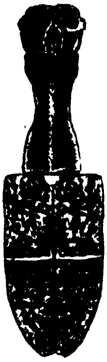
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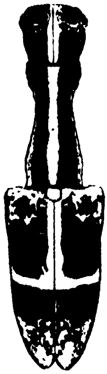
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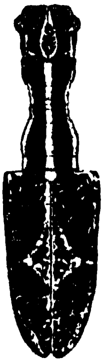
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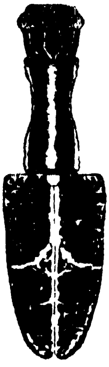
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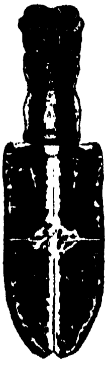
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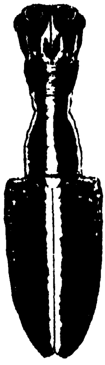
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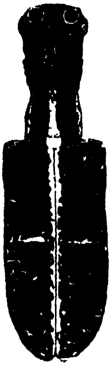
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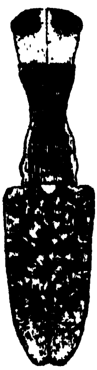
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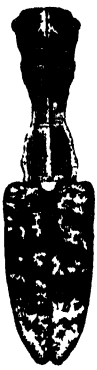
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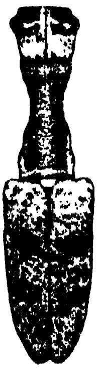
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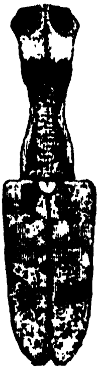
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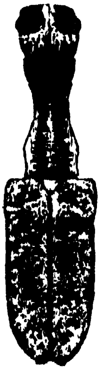
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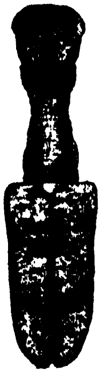
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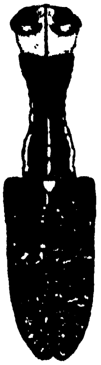
PLATE 2.



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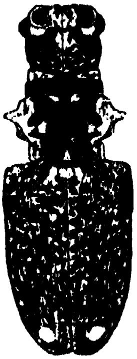

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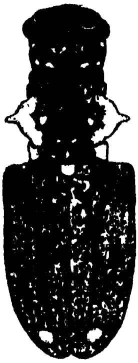

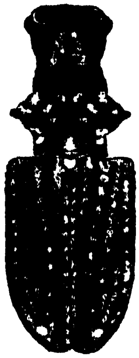

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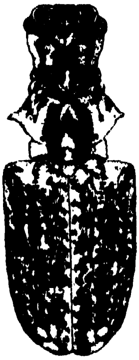

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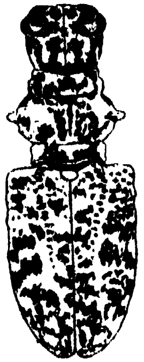

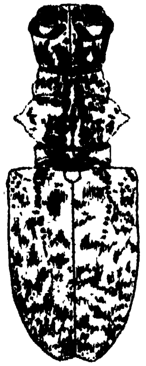

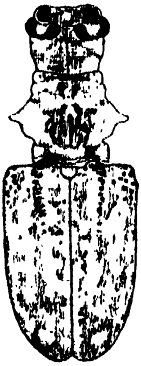

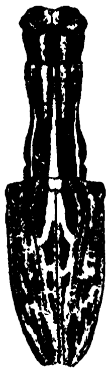

PLATE 3.

STRUCTURE AND DEVELOPMENT OF THE FEMALE GAMETOPHYTE IN CROTALARIA INTERMEDIA KOTSCHY.

BY ASOKA KUMAR PAUL and ROBINDRA MOHON DATTA
Of the Jute Agricultural Research Institute, Hoogly, W. Bengal, India.

ONE PLATE

INTRODUCTION

Crotalaria intermedia Kotschy, is a native of tropical Africa growing wild in the Nile land and lower Guinea.

The seeds of this plant were brought and grown in Bengal in 1936 with a view to see any economic possibilities.

Unless the life-history and the cytology of the plant are fully studied, no careful experiment can be planned and carried out. With that end in view, the present work was undertaken in 1936.

PREVIOUS WORK

Embryological studies on the genus *Crotalaria* were not done so far exhaustively. Cook[1] first studied the development of seed in *C. sagittalis* and described a few details of its embryogeny. He found a massive haustorial suspensor in the embryo. Samal[6], however, described the development of ovule, female gametophyte, embryo and endosperm of *C. juncea* and found the normal type of monosporic 8-nucleate embryosac. The suspensor was found to be massive and haustorial. Endosperm formation is free nuclear at first and wall formation takes place centripetally later on. He also studied the pollen tube growth and the cause of sterility in a large number of ovules due to the failure of pollen grains sending out the tubes and the occasional degeneration of the functional megaspore in the off-season.

MATERIAL AND METHODS

The materials were fixed mostly on sunny days between 11 a.m. and 1 p.m., and 2 p.m. and 3 p.m. in the months of June and July, 1936 from the plants grown in several culture pots. Fixation was done in Allen's modification of Bouin's fluid, Flemming's weak and Navashin; the best results were obtained with Navashin and Allen's Bouin. The usual procedure was followed. Sections were cut at 10–22 μ. in thickness to get the desired stages and stained with iron-haematoxylin and gentian violet.

OBSERVATIONS

The superior monocarpellary ovary bears on its marginal placenta one row of ovules. Their number varies from 11 to 14, though Oliver[8] says it to be 20 to 30 seeded from his materials collected from tropical Africa. These are arranged closely enclosing all the space of the ovarian chamber and crowded together on the placenta in the young condition at first. But with the growth and enlargement of the carpel, they become separated from one another and also from the ovarian wall.

The ovule initials arise as protruberances on the placenta and consist of homogeneous cells at first. The primordia of the integuments arise exogenously as annular rings at the base of the nucellar tissue in acropetal succession and the nucellar epidermis only takes part in their formation. Gradually by the cell division in the integuments they become thick and are observed to be 3– to 4–layered in case of the inner integument and the outer integument is composed of more than 3 to 4 layers of cells especially near the micropyle. The growth of the inner integument is not as vigorous as that of the outer one, though the growth of the latter is initiated earlier. Gradually the latter overtakes the inner one and forms the micropyle. The mature ovule ultimately becomes anatropous and bitegmic, before any meiotic division takes place in the megaspore mother cell.

The archesporium is hypodermal in origin and is observed to be differentiated in the second and third layers of the nucellar tissue as a polygonal cell of comparatively large dimensions with thicker and denser cytoplasm and relatively large nucleus and is not always strictly confined to a single cell. Often, two such archesporial cells have been observed to lie side by side (Fig. 1), though Samal[6] observed in *C. juncea* a single archesporial cell differentiating in the third layer of the nucellus, which either directly functions as a megaspore mother cell or cuts off a parietal cell before doing so. In a single instance, four archesporial cells, lying side by side, have been observed to develop into four megaspore mother cells. Further, in this material no parietal cell is seen to be cut off and the archesporium acts and functions directly as a megaspore mother cell.

The megaspore mother cell then undergoes a period of rest, during which it is pushed inwards by the periclinal divisions of the outer over-lying nucellar tissues. As a result, the megaspore mother cell is observed to be in the 4th or 5th layer of the nucellus during the heterotypic division as is observed in *C. juncea*[6]. In the resting stage the nucleus contains one conspicuous nucleolus embedded in the chromatin network. The general cytoplasm is much vacuolated containing 3 or 4 bigger vacuoles in addition to numerous smaller ones. (Fig 2). So far, in case of the multiple archesporium, only one of them was seen to develop into a functioning megaspore mother cell. On completing the reduction division, a cell plate is formed near about the central region of the cell, thus dividing it and forming thereby two dyads. In some cases, the lower dyad is a little bigger. The second divisions do not follow simultaneously in both the cells, although after division there is the resulting tetrad of four megaspores. When the division in the upper dyad is in the anaphasic stage, the division in the lower dyad is observed to start. The spindles are pointed in appearance. The homotypic spindles do not lie parallel to the long axis of the ovule nor at right angles to each other. The upper spindle is somewhat oblique. After completion of the divisions and proper development and necessary growth of the respective spores, an oblique "T"-shaped tetrad is organized (Fig. 3). Such a type of tetrad was recorded by Samal[6] also. The four megaspores, thus formed, differ in size and shape. The middle pair is the smallest; the uppermost (micropylar) intermediate; and the lowest (chalazal) the largest of all. Later on, the upper three megaspores show various types of contraction leading to ultimate degeneration, while the chalazal one alone functions. These three upper cells after complete degeneration and disintegration are observed as dark-staining shapeless masses covering and capping the functional and developing megaspore. In a particular case, even after degeneration, "T"-shape is not lost (Fig. 4).

The active megaspore gradually increases in size and elongates considerably. It is somewhat pointed at the basal end and broad at the apex. Its nucleus does not divide until the cell increases 2 to 3 times in volume. In course of growth and development, it crushes some adjacent nucellar tissues, which degenerate. These are observed as dark-staining shapeless islands surrounding the developing spore. It is much vacuolated and its nucleus is lying in the center. Afterwards, the nucleus of the fully developed megaspore divides into two daughter nuclei near about the center. These two daughter nuclei move and migrate towards the opposite poles, being inter-connected by the protoplasmic strands and the 2-nucleate sac is filled with numerous vacuoles, some big and some small. (Fig. 5). These two nuclei again divide to form the 4-nucleate stage, where the central vacuole becomes very prominent (Fig. 6). The divisional spindles are not parallel to the longitudinal axis of the cell but they lie somewhat obliquely; spindles are pointed. These four nuclei again divide simultaneously to reach the eight-nucleate stage of the sac (Fig. 7); the quartet being noticed at each pole with a bigger vacuole in the center. The micropylar end enlarges and becomes broader and the lower end is a little tapering, as reported by the writers (4) in a note.

Simultaneously with the organization of the egg-apparatus and the antipodals, one nucleus from each pole migrates away and meets each other. They lie side by side about the upper as well as the central region of the sac. The process of fusion is very slow just as in *C. juncea*[6]. Eight nucleate stage with two unfused polars are found usually two or three days before anthesis.

After the maturity of the embryo-sac, the volume no doubt increases but the surrounding nucellar tissues are not found to be crushed out nor the sac comes in contact with the cells of the integument as recorded by Samal[6].

The synergids are pyriform with vacuoles at their bases and the slightly elongated egg lies just a little below them. The egg is not, however, vacuolated (Fig. 8). No filiform apparatus in the synergids is noticed.

After polar fusion the secondary nucleus increases in size at least two times.

The mature embryo-sac is not cylindrical. The three antipodal cells are practically cut off and separated; they are later observed in the wedge-shaped basal groove, where they disorganize along with the tubular portion of the sac before fertilization and the embroyo-sac is seen rounded at the chalazal end. Reeves[5] found in *Medicago sativa* a partial disorganization of the chalazal groove with antipodals. Samal[6], however, records complete disorganization before fertilization. The early disorganization of the antipodals before fertilization corroborates the findings of Guignard[2], who holds that the antipodals persist for a long time in the Mimosoideae and Caesalpinioideae but they degenerate earlier in the Papilionatae.

SUMMARY

1. The ovule is anatropous and bitegmic.
2. More than one archesporial cell are observed, which are hypodermal in origin. Only one develops. It directly acts as a megaspore mother cell without cutting off any parietal cell.
3. The megaspore mother cell after reduction division forms an oblique "T"-shaped tetrad of magaspore; the chalazal one becomes functional.
4. The mature embryo-sac is 8-nucleate and is of monosporic eight-nucleate (normal) type.
5. The antipodals occur as cells and degenerate early before fertilization.

ACKNOWLEDGEMENT

In the end, we wish to record our grateful thanks to Dr. S. K. Mukherjee, Curator of the Herbarium, Royal Botanic Gardens, Sibpur, Calcutta, for information about the systematics of this plant.

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ILLUSTRATIONS

[The figures were drawn with the aid of a camera lucida at the drawing board level. The magnification is given along with each figure.]

PLATE I

FIG. 1. Two archesporial cells, one bigger than the other, in the hypodermal region of the nucellus. X 150.

2. Megaspore mother cell developing. X 1600.

3. An oblique "T"-shaped tetrad of megaspores. X 1600.

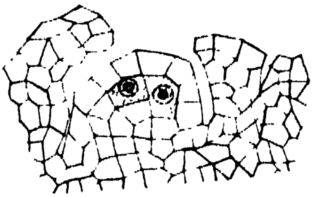
4. Degeneration of the three megaspores forming "T"-shaped and blackened mass at the top. X 1600.

5. Binucleate embryosac with degenerated megaspores at the top. X 1600.

6. Four-nucleate embryosac. X 1600.

7. Eight-nucleate embryosac. X 1600.

8. Two synergids with the egg and the secondary nucleus just below the egg. Ca. X 200.



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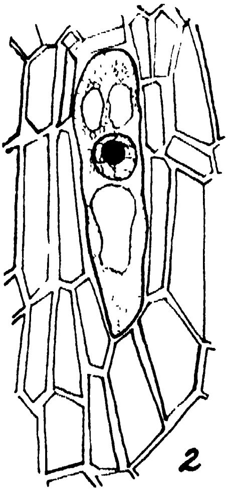

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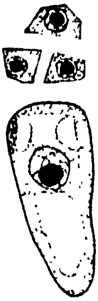

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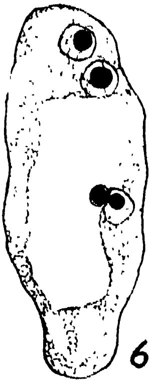

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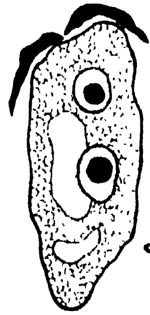

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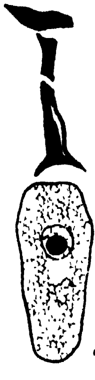

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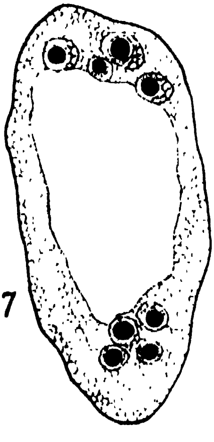

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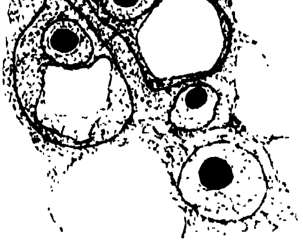

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PLATE 1.

STUDIES ON THE CONTROL OF FECAL-BORNE DISEASES IN NORTH CHINA. XV. AN APPROACH TO THE QUANTITATIVE STUDY OF THE HOUSE FREQUENTING FLY POPULATION. C. THE CHARACTERISTICS OF A RURAL FLY POPULATION *.

BY CH'ING HUA MENG and GERALD F. WINFIELD

Of the Department of Biology, Cheeloo University, Tsinan, Shantung, China.

INTRODUCTION

In the first of this series of papers on an approach to the quantitative study of the house frequenting fly population (Meng and Winfield, 1941) a method of utilizing trapping for enumerating the fly population was presented. In the second paper the characteristics of an urban fly population as shown by the application of this method was reported (Meng and Winfield, 1941a). In this paper the results of using it in the study of the fly population of a rural area will be presented.

MATERIALS AND METHODS

The rural area studied is located about 22 miles to the east of Tsinan and consisted of the market town of Lungshan and three nearby villages. Trappings were carried out from May to September of 1937 in 18 stations in Lungshan, Hu Chung P'o, Tung Hsu Ma, and Ya Chuang. The stations can be briefly characterized as follows:

Indoor stations (Living rooms)

Station 1. A dirty home in Hu Chung P'o.
Station 2. A clean home in Hu Chung P'o.
Station 3. A clean home in Hu Chung P'o.
Station 4. A clean home in Tung Hsu Ma.
Station 5. A dirty home in Tung Hsu Ma.
Station 6. A clean home in Ya Chuang.
Station 7. A clean home in Ya Chuang.
Station 8. A clean home in Lungshan.
Station 9. A dirty home in Hu Chung P'o.

Outdoor stations (Courtyards)

Station 10. A clean court in Hu Chung P'o.
Station 11. A dirty court in Hu Chung P'o.
Station 12. A Clean court in Hu Chung P'o.

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* This study was financed by the Rockefeller Foundation.

Station 13. A clean court in Tung Hsu Ma.
Station 14. A clean court in Tung Hsu Ma.
Station 15. A clean court in Ya Chuang.
Station 16. A clean court in Ya Chuang.
Station 17. A dirty court in Hu Chuang P'o.
Station 18. A dirty court in Lungshan.

With the exception of Station 1, which consisted of two rooms, all of the indoor stations consisted of three rooms. The light in all stations was not strong, as is the case with the rural homes in North China. Few flies were observed in the rooms during the several visits made by one of us (Meng). Some of the comparisons of the relative cleanliness of the rooms and courts are indicated by the words "dirty" and "clean". Even the clean stations would not measure up to modern standards of cleanliness though a few may have approached it. All the outdoor stations were much alike except Station 18 which was the courtyard of a pork-shop in which pigs were kept.

The trappings and calculations of the density indices were carried out as described in the preceding paper (Meng and Winfield, 1941a). One important modification which may have affected the results should be noted. In order to protect the tent traps used in the outdoor stations from being upset by dogs and other animals, it was necessary to hang them against the courtyard wall. To do this, wooden bottoms were fastened to the legs of the traps. The bait was set on these bottoms. As the traps were hung against the wall flies could approach the bait from only three sides instead of four as was the case with traps on the ground. This may have resulted in a smaller catch of flies.

PRESENTATION OF DATA

During the course of the five months of trapping, traps remained in place in the 18 stations for a total of 10,184 day light trapping hours with a total of 101,481 flies caught. Of this number, 24,545 were classified as shown in Table 1. The great majority of the flies taken were trapped in the outdoor stations. The percentages shown in Table 1 are the percentages of flies actually caught and classified. Of the total catch 17.7 per cent were *Musca vicina,* 32.2 per cent were *Chrysomyia megacephala,* and 50.1 per cent belonged to the *Other species group* which was made up of the different species listed in the table. Some 11.6 per cent of the catch belonged to rare or wild species which are of no importance to public health and so were left unclassified.

TABLE 1.—*Showing the number and percentage belonging to each species of flies trapped in 18 trapping stations in Lungshan area between May and September, 1937.*

	All stations	Indoor stations	Outdoor stations
Station numbers	1-18	1-9	10-18
Type of trap used	Clock and tent	Clock	Tent
Total number of daylight trapping hours	10,184	4,943	5,241
Total number of flies caught	101,481	3,968	97,513
Total number of flies classified	24,545	3,907	20,638
Percentage of classified flies:			
Musca vicina	*17.7*	*95.5*	*14.5*
Chrysomyia megacephala	*32.2*	*1.5*	*33.4*
Other species group—			
Muscina stabulans	9.7	0.5	10.1
Genus *Sarcophaga*	10.1	0.2	10.5
Lucilia sericata	12.2	1.9	12.6
Miscellaneous species group—			
Lucilia caesar	4.5	0.1	4.7
Musca sorbens	0.4	0.0	0.4
Musca hervei	1.4	0.0	1.4
Aldrichiella and *Calliphora*	0.1	0.0	0.1
Stomoxys calcitrans	0.1	0.0	0.1
Unidentified	11.6	0.3	12.2
Group total	18.1	0.4	18.9
Group total	*50.1*	*3.0*	*52.1*

The fly density indices and the corrected percentages calculated from them for all of the 18 stations are shown in Table 2. These indices show the average number of flies caught per daylight trapping hour for the entire five months of the trapping period.

TABLE 2.—*Showing the general and specific fly density indices and the corrected percentages of flies belonging to the various species and groups caught in each station of the Lungshan area during May to September, 1937.*

A.—Indoor stations living rooms

Station number	Type of station	Fly density index							
		All flies	*Musca vicina*	*Ch. megacephala*	Other species group				
					Group total	*Mu. stabulans*	Genus *Sarcophaga*	*Lucilia sericata*	Miscellaneous
1	Dirty	20.8	20.4	0.20	0.20	0.08	0.06	0.00	0.06
2	Clean	7.8	7.8	0.00	0.00	0.00	0.00	0.00	0.00
3	Clean	7.5	6.7	0.36	0.41	0.03	0.20	0.00	0.18
4	Clean	26.9	26.2	0.50	0.22	0.00	0.18	0.04	0.00
5	Dirty	44.5	44.3	0.15	0.00	0.00	0.00	0.00	0.00
6	Clean	34.8	28.4	1.72	4.71	0.47	3.82	0.11	0.31
7	Clean	10.7	10.5	0.06	0.12	0.00	0.12	0.00	0.00
8	Clean	7.9	7.5	0.20	0.23	0.03	0.05	0.00	0.15
9	Dirty	19.5	18.4	0.55	0.56	0.04	0.29	0.10	0.13
Room index		20.0	18.9	0.41	0.72	0.07	0.53	0.03	0.09

A.—Indoor stations living rooms—Continued

Station number	Type of station	Corrected percentages						
		Musca vicina	*Ch. megacephala*	Other species group				
				Group total	*Mu. stabulans*	Genus *Sarcophaga*	*Lucilia sericata*	Miscellaneous
1	Dirty	98 1	0.95	0.95	0.38	0.29	0.00	0.28
2	Clean	100.0	0.00	0.00	0.00	0.00	0.00	0.00
3	Clean	89.7	4.82	5.47	0.40	2.67	0.00	2.40
4	Clean	97.3	1.88	0.82	0.00	0.67	0.15	0.00
5	Dirty	99.7	0.30	0.00	0.00	0.00	0.00	0.00
6	Clean	81.5	4.98	13.52	1.35	10.97	0.31	0.89
7	Clean	98.3	0.57	1.18	0.00	1.18	0.00	0.00
8	Clean	94.6	2.50	2.90	0.38	0.62	0.00	1.90
9	Dirty	94.3	2.83	2.87	0.20	1.49	0.51	0.67
Room index		94.4	2.00	3.60	0.35	2.65	0.15	0.45

B.—Outdoor stations, courtyards

Station number	Type of station	Fly density index							
		All flies	*Musca vicina*	*Ch. megacephala*	Other species group				
					Group total	*Mu. stabulans*	Genus *Sarcophaga*	*Lucilia sericata*	Miscellaneous
10	Clean	123.7	3.2	57.1	63.4	11.8	13.5	7.9	30.2
11	Dirty	244.0	8.8	122.8	112.4	19.1	39.5	16.8	37.0
12	Clean	125.7	2.2	8.7	74.8	8.9	23.0	12.1	30.8
13	Clean	162.4	17.7	60.0	84.7	7.7	58.1	21.6	47.6
14	Clean	501.7	19.9	267.4	214.4	16.3	53.1	21.0	124.0
15	Clean	473.2	10.6	215.4	247 2	51.6	54.8	22 5	118.3
16	Clean	718.0	6.2	269.8	442.0	57.7	111.1	41.3	231.9
17	Dirty	525.4	20.0	307.4	197.8	32.6	65.3	28.3	71.6
18	Dirty	709.4	175.1	374.1	160.2	19.2	103.4	4.7	32.9
Court index		398.4	29.3	191.6	177.5	25.0	58.6	13.4	80.5

Station number	Type of station	Corrected percentages						
		Musca vicina	*Ch. megacephala*	Other species group				
				Group total	*Mu. stabulans*	Genus *Sarcophaga*	*Lucilia sericata*	Miscellaneous
10	Clean	2.6	46.2	51.2	9.5	10.9	6.4	24.4
11	Dirty	3.6	50.3	46.1	7.8	16.2	6.9	15.2
12	Clean	1.7	38.8	59.5	7.0	18.3	9.7	24.5
13	Clean	10.9	37.0	52.1	4.8	11.5	6.5	29.3
14	Clean	4.0	53.3	42.7	3.2	10.6	4.2	24.7
15	Clean	2.2	45.6	52.2	10.9	11.5	4.8	25.0
16	Clean	0.9	37.5	61.6	8.0	15.5	5.8	32.3
17	Dirty	3.8	58.5	37.7	6.3	12.4	5.4	13.6
18	Dirty	24.7	52.7	22.6	2.7	14.6	0.7	4.6
Court index		7.3	47.9	44.8	6.4	13.4	4.6	20.4

C.—All stations, living rooms and courts

Station number	Type of station	Fly density index							
		All flies	*Musca vicina*	*Ch. megacephala*	Other species group				
					Group total	*Mu. stabulans*	Genus *sarcophaga*	*Lucilia sericata*	Miscellaneous
Area index		209.2	24.1	96.0	89.1	12.5	27.0	9.2	40.4

C.—All stations, living rooms and courts—Continued

Station Number	Type of station	Corrected percentages						
		Musca vicina	*Ch. megacephala*	Other species group				
				Group total	*Mu. stabulans*	Genus *Sarcophaga*	*Lucilia sericata*	Miscellaneous
Area index		11.6	46.0	42.4	6.0	13.0	4.4	19.0

The highest density index in any of the nine indoor stations was that of Station 5 where a general density index of 44.5 was recorded. This station was classified as being "dirty" and was located in the village of Tung Hsu Ma. On the other hand the next highest index of 34.8 was in Station 6 which was reported as "clean" and was located in Ya Chuang. The lowest index for any of the indoor stations was 7.5 for Station 3. The average general fly density index for all the rooms was 20.0.

By far the most important species caught in houses, as was the case in the Tsinan area (Meng and Winfield, 1941a), was *Musca vicina.* The highest index for this species was 44.3 and the lowest was 6.7 while the index for all nine stations was 18.9. *Chrysomyia megacephala* was taken in 8 out of the 9 stations but its density was very low with an average of only 0.41 for the nine stations. The numbers of the *Other species group* in these rural rooms was also low with an average of only 0.72 for all stations. One station (No. 6) showed an index of 4.71.

The overwhelming importance of *Musca vicina* within the houses is best shown by the corrected percentages. In one station (No. 2) 100 per cent of the flies belonged to this species while in only two stations (Nos. 3 and 6) the percentage fall below 94 per cent. For the nine stations 94.4 per cent of the flies caught were *Musca vicina.* In two stations (Nos. 3 and 6) *Chrysomyia megacephala* made up more than 4 per cent of the flies while in two others (Nos. 8 and 9) it made up more than 2 per cent. In the other five stations this species accounted for from none to 1.88 per cent of the flies present. The average for all nine stations was 2.00. The *Other species group* was represented in 7 of the 9 stations. It was most numerous in Station 6 where it made up 13.52 per cent of the flies present with an average of 3.6 per cent in all the stations. The most important species in this group were those belonging to the Genus *Sarcophaga* since they made up 2.65 per cent of the flies present in the nine stations.

The general density indices for the outdoor stations run much higher than do those of the indoor ones, as was the case in the urban area. The index for all species ranged from high consisting of 718.0 in Station 16 to low consisting of 123.7 in Station 10, with an average of 398.4. The specific indices for the different species and groups varied much more than was the case with the indoor stations. *Musca vicina* was present in all stations with the highest density for this species of 175.1 in Station 18 and lowest with 2.2 in Station 12. The average density for all stations was 29.3, which is somewhat higher than its density in the indoor stations. If the one station with high density is removed then the average index for the remaining eight is only 11.2 which is considerably below that of the indoor stations. It will be remembered that Station 18 which showed a high *Musca vicina* index was the courtyard of a pork-shop where pigs were kept. The fact that pig manure is the best breeding medium for this species, as we shall show in the succeeding paper of this series, fully accounts for this abnormally high *vicina* index in this station. This data would indicate that the density of this species in the houses of the Lungshan area is probably greater than it is in the courtyard except when special conditions as in Station 18 supervene.

The specific index of *Chrysomyia megacephala* varied from 374.1 in Station 18 to 48.7 in Station 12 with an average of 191.6 for the nine stations. This average index was the highest for any of the species or groups present though the *Other species group* was a close second with an average index of 177.5. This latter group showed a higher index in the station with its maximum number (Station 16 with an index of 442.0) than the station showing the maximum *Chrysomyia megacepala* index had. The lowest index for the *Other species group* was 63.4 in Station 10. Within the *Other species group* the *Miscellaneous group* was most abundant with an average index for the nine stations of 80.5. The Genus *Sarcophaga* came second with an average index of 53.6. *Muscina stabulans* had an average index of 25.0 while *Lucilia sericata* had an average index of 18.4.

The relative importance of the different species is shown by the corrected percentages. *Musca vicina* made up 24.7 per cent of the flies in Station 18 and 10.9 per cent of the flies in Station 13 but did not exceed 4 per cent in any of the other stations. It had an average of 7.3 per cent in all nine stations. *Chrysomyia megacephala,* on the other hand, made up from 37.0 to 58.5 per cent of the flies in the different stations and with an average of 47.9 per cent for the nine. The *Other species group* ranged from 61.6 to 22.6 per cent with an average of 44.8. Within this group the *Miscellaneous group* accounted for 20.4 per cent of all flies present in all stations, with the Genus *Sarcophaga* accounting for 13.4 per cent *Muscina stabulans* for 6.4 and *Lucilia sericata* for 4.6 per cent.

The way in which the density indices in the outdoor and indoor stations compare with each other for the four villages is shown in Table 3 (A). The outdoor population showed a density which ranged from about 10 times as great as that of the indoor stations in Tung Hsu Ma to almost 100 times

TABLE 3.—*Comparisons of fly density indices and corrected percentages of flies belonging to the three main groups for different classes of stations.* (Lungshan, June to September, 1937.)

Classes of stations	General density index	*Musca vicina*		*Chrysomyia megacephala*		Other species group	
		Index	Per cent	Index	Per cent	Index	Per cent
–Living rooms and courtyards compared							
a. Hu Chung P'o							
Rooms (1–3, and 9)	13.9	13.3	95.9	0.3	2.0	0.3	2.1
Courts (10–12, and 17)	254.7	8.6	3.4	134.0	52.6	112.1	44.0
Village index	134.3	11.0	8.2	67.1	50.0	56.2	41.8
b. Tung Hsu Ma							
Rooms (4 and 5)	35.6	35.2	98.8	0.3	0.9	0.1	0.
Courts (13 and 14)	332.0	13.8	5.7	168.7	49.3	149.5	45.
Village index	183.8	27.0	14.7	82.0	44.6	74.8	40.
c. Ya Chuang							
Rooms (6 and 7)	22.7	19.4	85.5	0.9	3.9	2.4	10.6
Courts (15 and 16)	595.6	8.4	1.4	242.6	40.7	344.6	57.9
Village index	309.1	13.9	4.5	121.7	39.4	173.5	56.1
d. Lungshan							
Room (8)	7.9	7.5	94.6	0.2	2.5	0.2	2.9
Court (18)	709.4	175.1	24.7	374.1	52.7	160.2	22.6
Village index	358.6	91.3	25.5	187.1	52.2	80.2	22.3

B.—*The four villages compared*

a. Living rooms

Lungshan (8)	7.9	7.5	94.6	0.2	2.5	0.2	2.9
Hu Chung P'o (1–3, and 9)	13.9	13.3	95.9	0.3	2.0	0.3	2.1
Ya Chuang (6 and 7)	22.7	19.4	85.5	0.9	3.9	2.4	10.6
Tung Hsu Ma (4 and 5)	35.6	35.2	98.8	0.3	0.9	0.1	0.3
Room index	20.1	18.9	94.0	0.4	2.1	0.8	3.9

b. Courtyards

Hu Chung P'o (10–12, and 17)	254.7	8.6	3.4	134.0	52.6	112.1	44.0
Tung Hsu Ma (13 and 14)	332.0	18.8	5.7	163.7	49.3	149.5	45.0
Ya Chuang (15 and 16)	595.6	8.4	1.4	242.6	40.7	344.6	57.9
Lungshan (18)	709.4	175.1	24.7	374.1	52.7	160.2	22.6
Court index	472.9	52.7	11.1	228.6	48.3	191.6	40.5

in Lungshan. The general index of the outdoor stations was 23 times that of the indooor stations. The relationship of the densities of the different species in the outdoor and indoor stations was much the same in all four villages except in Lungshan where *Musca vicina* was exceptionally abundant in the outdoor stations due to the special conditions already mentioned.

The range of variations in fly density and species composition among the four villages is shown in Table 3 (B). The number of stations trapped in each village differed with only one each of indoor and outdoor stations in Lungshan, two each in Tung Hsu Ma and Ya Chuang, and three each in Hu Chung P'o. The indices of the villages must not, therefore, be considered as equally representing the fly population present in them. The general index for the indoor stations ranged from 7.9 in Lungshan to 35.6 in Tung Hsu Ma while that for the outdoor stations ranged from 254.7 for Hu Chung P'o to 709.4 in Lungshan. In all four villages the population in the indoor stations was dominated by *Musca vicina* though in Ya Chuang a fair number of *Other species group* flies was present. In the outdoor stations only in Lungshan was *Musca vicina* very important while *Chrysomyia megacephala* was the dominant species in all villages except Ya Chuang where the *Other species group* was the most important.

The month by month variations of the density and species make up of the fly population of the whole Lungshan area as shown by the average density index for all indoor and outdoor stations and the percentage of flies belonging to each of the important groups and species are shown in Table 4 and graphed in Figures 1 to 4.

No flies were taken in the indoor stations during the months of May and June. The density of *M. vicina* was always relatively low, rising up through July to a peak of 42.3 in August [Tab. 4 (A)]. This compares with a peak of 95.6 for July in the indoor stations of the Tsinan area (Meng and Winfield, 1941a). In all months from 94 to 98 per cent of the flies belonged to this species while *Chrysomyia megacephala* and the *Other species group* together made up the remaining portion.

TABLE 4.—*Showing the mean fly density indices and the corrected percentages of all flies caught each month in the indoor and outdoor stations in the Lungshan rural area.*

Month	Index of all flies	*Musca vicina*		*Chrysomyia megacephala*		Other species group: Group total	
		Index	Per cent	Index	Per cent	Index	Per cent
A.—Indoor stations							
May	-----	-----	-----	-----	-----	-----	-----
June	-----	-----	-----	-----	-----	-----	-----
July	8.7	8.4	98.0	0.1	0.8	0.2	1.3
August	45.0	42.3	94.1	1.4	3.0	1.3	2.9
September	25.4	24.8	98.6	0.3	1.0	0.3	0.4

Other species group (Continued)

Month	*Muscina Stabulans*		*Sarcophaga*		*Lucilia sericata*		Miscellaneous	
	Index	Per cent	Index	Per cent	Index	Per cent	Index	Per cent
May	-----	-----	-----	-----	-----	-----	-----	-----
June	-----	-----	-----	-----	-----	-----	-----	-----
July	0.1	0.9	0.0	0.0	0.1	0.2	0.01	0.12
August	0.2	0.4	0.2	0.4	0.9	2.1	0.01	0.02
September	0.1	0.1	0.1	0.1	0.1	0.1	0.01	0.00

B.—Outdoor stations

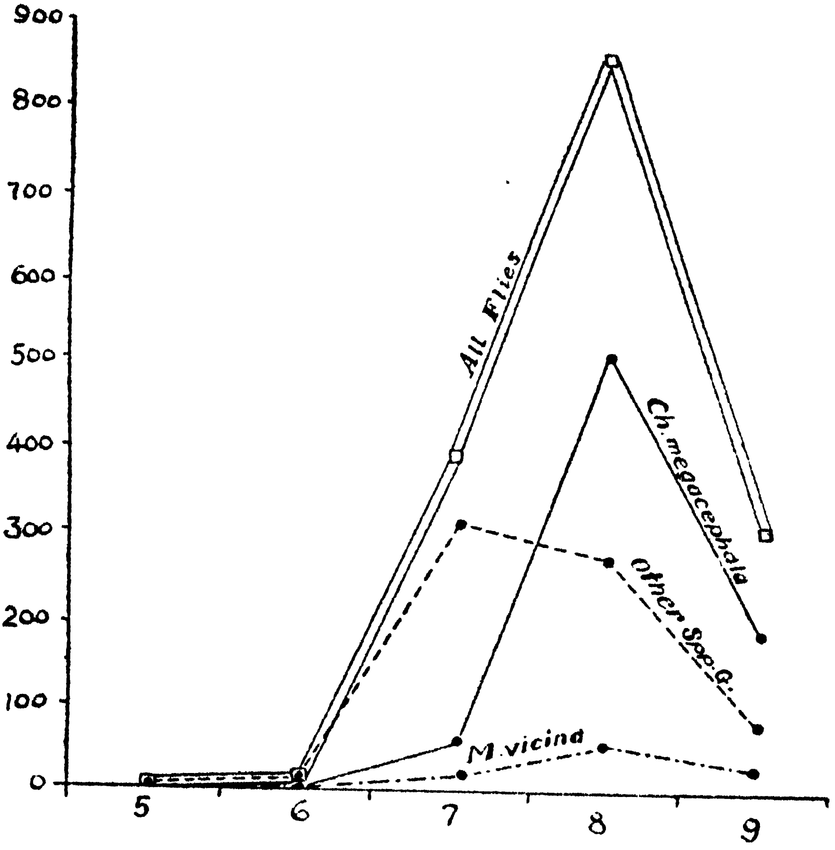
Month	Index of all flies	*Musca vicina*		*Chrysomyia megacephala*		Other species group: Group total	
		Index	Per cent	Index	Per cent	Index	Per cent
May	1.3	0.0	0.0	0.0	0.0	1.3	100.0
June	7.3	0.7	9.6	0.2	2.2	6.4	88.2
July	399.1	24.2	6.0	63.7	15.9	311.2	78.1
August	853.7	65.7	7.8	507.3	59.4	280.7	33.0
September	306.2	26.6	8.8	194.4	63.5	85.2	27.7

Other species group (Continued)

Month	*Muscina Stabulans*		*Sarcophaga*		*Lucilia sericata*		Miscellaneous	
	Index	Per cent	Index	Per cent	Index	Per cent	Index	Per cent
May	0.2	12.7	1.0	74.6	0.0	0.0	0.2	12.7
June	2.5	34.0	1.3	17.9	0.8	11.6	1.8	24.7
July	71.4	17.9	89.1	22.3	52.4	13.1	98.3	24.8
August	24.0	2.8	61.7	7.2	34.7	4.1	160.3	18.8
September	3.8	1.2	16.3	5.3	6.0	1.9	59.1	19.3

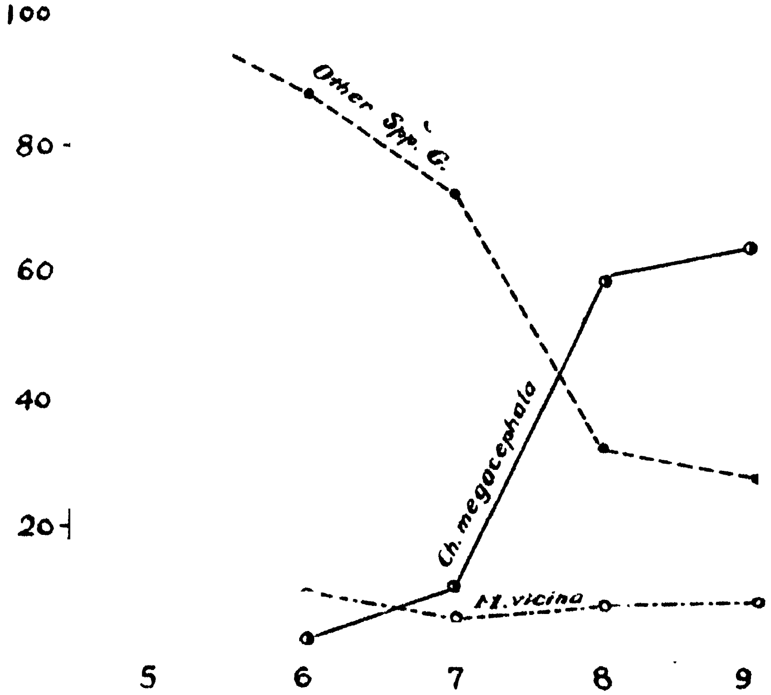
In the outdoor stations flies were taken in all months between May and September. The general density index was highest in August when it reached 853.7 (Fig. 1). The comparable peaks for the Tsinan area occurred in September and reached 1,731.9 flies. *Musca vicina* appeared in the outdoor

Figure 1



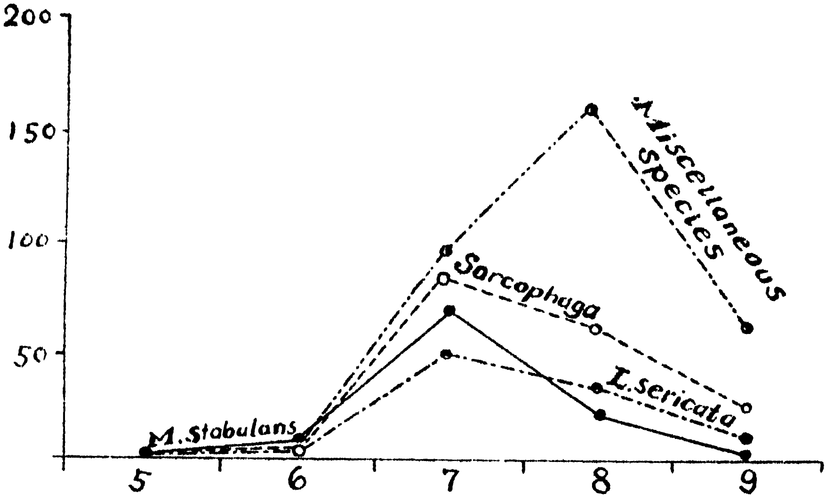
stations in June which was a month earlier than it was taken in the indoor stations. The density of this species reached a peak of 65.7 in August which was higher than the peak in indoor stations. It should be remembered that the exceptional conditions of Station 18 are largely responsible for this greater density of *M. vicina* in the outdoor stations. The Tsinan area peak for this species in the outdoor stations was 162.4 and also occurred in August. *M. vicina* was relatively most important in June when it made up 9.6 per cent of the flies in the outdoor stations (Table 4, fig. 2). The density of *Chrysomyia megacephala* in this rural area paralleled its density in the Tsinan area since only a few adults were trapped in June, the number rose up through July to a peak of 507.8 in August. In Tsinan, however, the peak came in September and reached 1,480 flies. This was the most common species in August and September comprising 59.4 and 63.5 per cent of the population in these months respectively (Fig. 2).

Figure 2



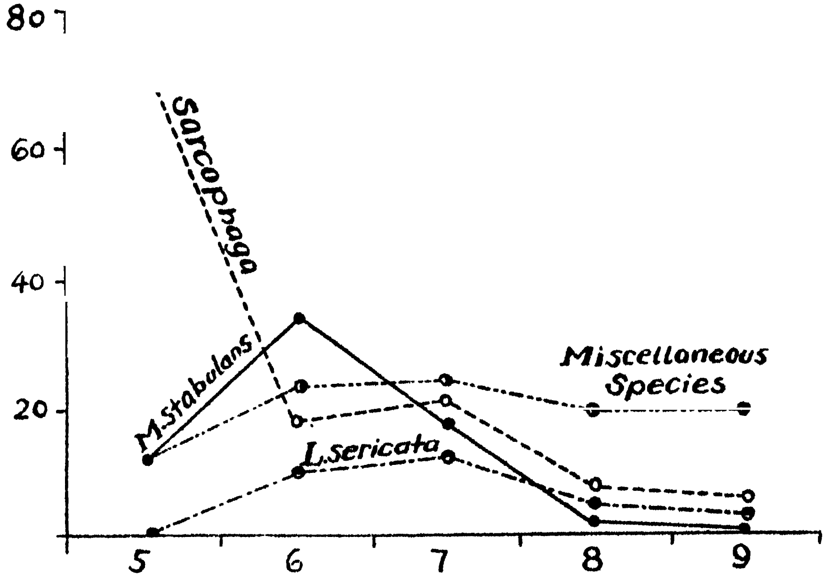
The only flies caught in May in the outdoor stations belonged to the *Other species group.* The peak for this group reached 311.2 and occurred in July. The number present in August was only slightly smaller (Fig. 1). This single peak in July compares with a double peak for this group in the Tsinan area, one of 190.6 in June and the other of 179.0 in September. It is apparent, therefore, that this group is relatively more abundant in Lungshan than in Tsinan. This fact can be explained on the basis of what is known about breeding habits of the species in this group. (See below and succeeding paper in the series). The *Other species group* was the most common group present in May, June, and July (Fig. 2). The indices for the species composing the *Other species group* are shown in Figure 3. The *Miscellaneous group* which included the unidentified species was the most abundant with a peak of 160.3 in August. It was followed by the genus *Sarcophaga* with a peak of 89.1 in July. *Muscina stabulans* and *Lucilia*

Figure 3



sericata also show July peaks. The percentage of the population belonging to each of these species is shown in Figure 4. *Sarcophaga* made up the highest percentage in May, *Muscina stabulans* in June, and the *Miscellaneous group* in July, August, and September.

Figure 4



Comparisons of the fly population of the Lungshan rural area with that of the Tsinan urban area (Meng and Winfield, 1941a) are easily made by studying Table 5. The general density index for the indoor stations shows that the Tsinan area had a definitely larger fly population than did the Lungshan area during the months of June, July, and August but that in September the two populations were quite similar, with the Tsinan index being only slightly higher than the Lungshan one. In both areas, the dominant species of the indoor stations was *Musca vicina,* which made up over 93 per cent of the mean population, and it was considerably more dense in Tsinan particularly during June and July. The mean general density index, as well as the mean index of *Musca vicina,* for the urban area, was more than three times as great present in both areas but the indices were very low. as that for the rural one. *Chrysomyia megacephala* occurred in the indoor stations of both areas in small numbers, though the index for this species was considerably higher for Tsinan than for Lungshan. Similarly the *Other species group* was Lungshan only during the month of July while during May,

In the outdoor stations, the general index was higher in June, August, and September the Tsinan index was considerably higher. *Musca vicina* was more abundant in the Tsinan outdoor stations during all five months for which comparable data are available. *Chrysomyia megacephala,* which was the dominant outdoor species in both areas, was more abundant in Lungshan only during July, while its density during June, August, and September was much greater in Tsinan than in Lungshan. The *Other species group* had a higher density index in Tsinan than in Lungshan during May, June, and September but was considerably higher in Lungshan in July and August.

Among this latter group, *Muscina stabulans,* Genus *Sarcophaga,* and *Lucilia sericata* were definitely more abundant in Tsinan outdoor stations during May, June, and September, while their density indices in July were decidedly greater in the rural than in the urban area. On the other hand, during the month of August, the density of *Muscina stabulans* was somewhat greater in Lungshan than in Tsinan; the index for *Sarcophaga* was slightly higher in Tsinan than in Lungshan; while that for *Lucilia sericata* was decidedly much higher in Lungshan than in Tsinan. The *Miscellaneous group* was more abundant in Tsinan outdoor stations during May and June and was less abundant in this area during July, August, and September.

As shown in the penultimate line of Table 5 the mean density index of all flies in the outdoor stations as well as those of *Musca vicina* and *Chrysomyia megacephala* was decidedly higher in the urban than in the rural area, while, on the other hand, the density indices of the *Other species group* in outdoor stations of the two areas were almost equal. Among this latter group, the density indices of *Muscina stabulans* and *Sarcophaga* were definitely higher in Tsinan than in Lungshan; the indices for *Lucilia sericata* in the two areas were almost equal; while the mean index for the *Miscellaneous group* was decidedly much higher in the rural than in the urban area.

When the percentages of the mean indices shown in the last line of Table 5 is taken into account, it can be seen that both *Musca vicina* and *Chrysomyia megacephala* made up a higher percentage of the outdoor population in Tsinan than in Lungshan, while of those which belonged to the individual

TABLE 5.—*Comparison of the fly population of the Tsinan urban area (T) for 1936 with that of the Lungshan rural area (L) for 1937.*

Month	General density index		*Musca vicina* index		*Chrysomyia megacephala* index		Other species group index	
	T	L	T	L	T	L	T	L
A.—Indoor stations								
June	60.1	....	59.8	....	0.0	....	0.8	....
July	95.8	8.7	95.6	8.4	0.0	0.1	0.2	0.2
August	70.1	45.0	59.0	42.8	8.2	1.4	3.0	1.3
September	30.9	25.4	26.2	24.6	4.2	0.3	0.6	0.8
Mean	64.2	19.9	60.0	18.9	3.1	0.5	1.1	0.5
Percentage of mean	....	....	93.5	95.0	4.8	2.5	1.7	2.5

Month	General density index		*Muscina stabulans* index		Genus *sarcophaga* index		*Lucilia sericata* index		Miscellaneous species index	
	T	L	T	L	T	L	T	L	T	L
A.—Indoor stations (Continued)										
June	60.1	....	0.28	......	0.11	......	0.32	......	0.13	......
July	95.8	8.7	0.18	0.1	0.00	0.0	0.05	0.1	0.04	0.01
August	70.1	45.0	0.63	0.2	1.81	0.2	0.32	0.9	0.21	0.01
September	30.9	25.4	0.38	0.1	0.13	0.1	0.02	0.1	0.05	0.0
Mean	64.2	19.9	0.35	0.1	0.51	0.1	0.18	0.3	0.11	0.1
Percentage of mean			0.51	0.5	0.76	0.5	0.27	1.5	0.16	0.05

B.—Outdoor stations

May	81.9	11.3	0.3	0.0	0.0	0.0	81.7	1.3
June	227.6	7.3	34.6	0.7	2.5	0.2	190.6	6.4
July	198.9	399.1	136.3	24.2	1.0	63.7	61.6	311.3
August	1,233.7	853.7	162.4	65.7	997.5	507.3	123.7	280.7
September	1,781.9	306.2	54.4	26.6	1,480.5	194.4	197.0	85.2
Mean	704.7	313.5	77.6	23.4	496.3	153.1	130.8	137.0
Percentage of mean	----------	--------	1.0	7.5	70.4	48.8	18.6	43.7

Month	General density index		*Muscina stabulans* index		Genus *sarcophaga* index		*Lucilia sericata* index		Miscellaneous species index	
	T	L	T	L	T	L	T	L	T	L
B.—Outdoor stations (Continued)										
May	81.9	11.3	56.10	0.2	14.91	1.0	2.42	0.0	8.22	0.2
June	227.6	7.3	55.50	2.5	45.32	1.3	49.10	0.8	40.65	1.8
July	198.9	399.1	36.85	71.4	12.52	89.1	9.38	52.4	3.36	98.3
August	1 233.7	853.7	18.93	24.0	77.38	61.7	11.14	34.7	16.28	160.3
September	1,781.9	306.2	24.05	3.8	105.27	16.3	17.04	6.0	50.06	59.1
Mean	704.7	313.5	38.19	20.4	51.05	33.9	17.82	18.8	23.71	63.9
Percentage of mean			5.4	6.5	7.3	10.8	2.5	6.0	3.4	20.4

species of the *Other species group* as well as the entire group itself show the reverse.

All the foregoing comparisons when taken as a whole seem to justify the following conclusions. First, the indoor fly population in both areas is definitely dominated by *Musca vicina* which made up over 93 per cent of the mean population. This is due to the predilection which this fly manifests in entering the dark interior of houses while seeking for food and shelter. Second, the indoor population in the urban area is definitely more dense than in the rural area. This fact is correlated with the breeding habits of *Musca vicina,* the dominant indoor species, as will be shown in detail in the succeeding paper of this series. Third, the outdoor population is more dense in the urban area than in the rural area. This is due largely to the habit of *Chrysomyia megacephala* of breeding in liquid human feces in latrines and at feces cake drying grounds in and around the city. Feces cakes are not dried in the rural area. Fourth, the species which make up the outdoor population in the urban and the rural areas show certain important differences. *Chrysomyia megacephala* is the dominant species in both areas and it is definitely more abundant and constitutes a bigger percentage of the population in the urban area than in the rural one. *Musca vicina* is much more abundant and made up a bigger percentage of the population in the outdoor stations of the urban area than it is in the rural one. The *Other species group* is equally dense in both areas though it made up a bigger percentage of the population in the rural than in the urban area as did the individual species among this group. Among this group, both *Muscina stabulans* and Genus *Sarcophaga* were more dense in the urban than in the rural area; the indices for *Lucilia sericata* in the two areas were approximately the same; while the *Miscellaneous group* was definitely more dense in the rural than in the urban area. Most of these important differences can be explained in the light of the breeding habits and abundance of the breeding media which are suited to the different species concerned. The data which will make this point clear will be presented in the next paper of this series.

SUMMARY

A total of 101,481 flies was trapped by standard trapping methods in 9 indoor and 9 outdoor stations in four villages of the Lungshan rural area of West Shantung, China, between May and September 1937. A study of the density indices and species make up the population taken from these trappings revealed the following:

1. *Musca vicina* was the dominant species in the indoor stations comprising from 81.5 per cent to 100 per cent with an average of 94.4 per cent of the population, and with a density index of from 6.7 to 44.3 with an average of 18.9 for the nine stations. *Chrysomyia megacephala* and the *Other species group* made up the remaining portion of the indoor population.

2. *Chrysomyia megacephala* was the dominant species of the outdoor stations, making up from 37.0 per cent to 58.5 per cent with an average of 47.9 per cent of the population and with a density index of from 48.7 to 374.1 with an average of 191.6. The *Other species group* is the next in importance comprising from 22.6 per cent to 61.6 per cent with an average of 44.8 per cent of the population and with a density index of 63.4 to 442.0 and an average of 177.5. *Musca vicina* made up only a small percentage of the outdoor population with a low density index in all stations but one (18), where exceptional amounts of pig manure were available for breeding.

3. The outdoor population index was from 10 to 100 with an average of 23 times as large as was the indoor index in the four villages studied.

4. The four villages all showed different general fly density indices for both outdoor and indoor stations but the ratios of the indices of the various species to each other were similar in all four villages.

5. The month by month variations of the average density indices for the species in the 9 indoor stations showed that *Musca vicina* appeared in July, increased to a maximum number in August and declined thereafter, while the other species were negligible during all months.

6. The monthly variations in the outdoor stations showed that *Chrysomyia megacephala* appeared in late June and reached the highest point in August. The *Other species group* was already present when trapping started in May and rose to a maximum in July. *Musca vicina* appeared in June and was present in large number in August.

7. Comparisons between the fly population in the Lungshan rural area for 1937 with that of the Tsinan urban area for 1936 showed that:

(A) The indoor population in th urban area was definitely denser than in the rural area.

(B) *Musca vicina* was the dominant indoor species and constituted over 93 per cent of the population in both areas.

(C) The density of the outdoor population also was greater in the urban than in the rural area.

(D) *Chrysomyia megacephala* was the dominant species in the outdoor population of both areas and was definitely more dense and made up a bigger percentage of the population in the urban than in the rural area.

(E) The *Other species group* was equally dense out of doors in both areas although it made up a bigger percentage of the outdoor population in the rural than in the urban area as did the individual species of this group. Among this group, both *Muscina stabulans* and Genus *Sarcophaga* were definitely more dense in the urban than in the rural area; the indices for *Lucilia sericata* in the two areas were approximately the same; while the index for the *Miscellaneous group* was definitely much higher in the rural than in the urban area.

(F) *Musca vicina* was more dense and made up a bigger percentage of the outdoor population in the urban than in the rural area.

(G) Most of these differences in population density and species make up in the two areas seem to be correlated with breeding habits and opportunities for breeding as will be shown in the succeeding paper of this series.

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ILLUSTRATIONS

FIG. 1. Showing monthly variations in the mean fly density indices of all flies, *Musca vicina, Chrysomyia megacephala,* and the *Other species group* in outdoor stations. Ordinate: fly density; abscissa: months.

2. Showing monthly variations in the corrected percentages of all flies belonging to *Musca vicina, Chrysomyia megacephala,* and the *Other species group* in outdoor stations. Ordinate: percentage of flies; abscissa: months.

3. Showing monthly variations in the mean density indices of *Muscina stabulans,* genus *Sarcophaga, Lucilia sericata,* and *Miscellaneous species* of the *Other species group* in the outdoor stations. Ordinate: fly density; abscissa: months.

4. Showing monthly variations in the corrected percentages of all flies belonging to *Muscina stabulans,* genus *Sarcophaga, Luscilia sericata,* and the *Miscellaneous species* in the outdoor stations. Ordinate: percentage of flies; abscissa: months.

LIGATURES AND CONJUNCTIONS IN ILOKO

BY MORICE VANOVERBERGH
Belgian Missionary, Bauko, Mountain Province, Luzon

CHAPTER I. THE LIGATURE

I. THE LIGATURE *A* OR *ÑGA*

I. In the grammars of Revs. Naves and Lopez are formulated the following rules for the discrimination between the use of *a* and that of *n͠ga:*

1. Naves: *A* is used when placed between a word ending in a consonant and one beginning with a consonant; *N͠ga* is used when placed between a word ending in *a* and one beginning with *a.*

2. Lopez: *N͠ga* is used when following a word in *a; A* is used in all other cases.

Our own opinion: Euphony is the only rule and daily use the only teacher; but to make the use of both ligatures uniform in literature, we follow the opinion of most all serious Iloko writers, who actually accept the following rules:

A is written whenever it is followed by a word beginning with a consonant;

Ñga is written whenever it is followed by a word beginning with a vowel. Examples:

ti baláy a dakkél	the large house.
ti áso a bassít	the small dog.
ti púsa a bassít	the small cat.
ti narbá n͠ga agámman͠g	the ruined granary.
ti púso n͠ga agladin͠git	the heart that grieves.
ti dakkél n͠ga áso	the big dog.
ti púsa n͠ga immáy	the cat that came.
ti áso n͠ga úmel	the dumb dog.
ti bassít n͠ga ubín͠g	the small child.

II. This ligature is used to connect almost all members of the sentence with one another, and also to connect subordinate clauses with the principal one.

A. It is always used to translate the English relative pronoun except in one case, where the ligature *ti* takes its place.

Sometimes the term which in English is introduced by a relative pronoun, precedes the noun it modifies, exactly like an ordinary adjective and with the same nuance of meaning. Cfr. The Adjective. IV. General Remarks. I[1].

Ti táo ñga immáy, "the man who came", or *ti immáy a táo,* "the man who came" (with less stress on the clause "who came").

This illustrates the nature of the Iloko ligature *a* or *ñga,* which very often includes more or less the notion of a relative pronoun: *ti kabáyo a napigsá,* "the horse which is strong", and its inversion: *ti napigsá a kabáyo,* "the strong horse". Examples:

ti lakay nga immay	the old man who came.
dagití táo a mapán aglakláko ití abél	the men who go to sell cloth.
lakáykayo a dakkél únay ti síribna	you are old men who have much wisdom.
nakítami daydí ubiñg a nakaúram ití balaymi	we saw the child who burnt our house.
awán ti táo a saánna a kayát ti uminúm no mabalínna	there is no man who does not like to drink if he can.
dakami a nakapúkaw kadagití ámin a kúkuami	we who lost all our belongings.
ayabám ni Pédro a napán nañgála ití káyo idí naminsán a malém	call Peter who went to get wood the afternoon before last.

NOTE 1.—When the subject of a subordinate clause introduced by a relative pronoun is the same as that of the principal sentence, it is always expressed in the third person singular, when it stands for a possessive. In case it stands for a personal pronoun, it is omitted. Cfr. The Pronoun. I. Personal Pronouns. 1. Note IV.[2] Examples:

siká ñga addá nákemna	you that have sense.
siká ti Diósko ñga awán patíñggá ti imbágna	Thou art my God Whose kindness is infinite.
siák ñga adú ti kúkuana	I who have much property.
siák a napán kimmíta	I who went to see.
dakamí a nagsublí	we who came back.
dakayó a bassít ti pammátina	you who have little faith.
dakayó a mayát	you who are willing.
dakayó a narígat ti biágna	you whose lives are hard.
isúda a nasiñgpét ti panagbiágna	they who lead a virtuous life.
isúda a timmaráy	they who ran away.
dagití áso a kimmagát	the dogs that bit.
dakamí ti awán pirákna	we are those who have no money.
siká ti awán ásona	you are the one who has no dog.
siák ti napán nañgála ití ginatañgda	I was the one who went to get what they bought.
dakamí ti madi	we are those who refuse.
dakayó ti agtaráy	you are those who run.
isúda ti addá ásona	they are those who have dogs.

[1] Anthropos 26 (1931) 485.

[2] Anthropos 28 (1933) 686.

B. In the course of preceding papers we have very often touched on the subject of the ligature, when we explained the use of the different members of the grammatical sentence; however, to be complete, we give the following tables, which may serve as a recapitulation and at the same time supply all omissions; a third table will find its place under the ligature *ti*.

FIRST TABLE

The ligature *a* or *n͠ga* is used:

1. Between two substantives, when the last qualifies the first. Examples:

ti áso a babái	the bitch.
ti kaldín͠g a laláki	the he-goat.
ti baláy a káyo	the wooden house.
ti káwar a landók	the iron chain.

2. Between subtantives and attributes, or vice versa. Examples:

ti áso a dakkél	the large dog.
ti ubín͠g a bassít	the small child.
ti nasin͠gpét a balásan͠g	the virtuous girl.
ti napigsá a nuán͠g	the strong carabao.

3. Between numbers and substantives or attributes. Examples:

duá a táo	two men.
talló a babái	three women.
uppát a dakkél	four big ones.
san͠gapúlo a napigsá a kabáyo	ten strong horses.

4. Between personal pronouns of the first series and substantives, attributes or numbers. Examples:

dakamí a babaknán͠g	we rich men.
isúda a lalláki	they, men.
siká a babái	you, a woman.
siák a napan͠gláw	I, a poor man.
dakayó a duá	you two.
datayó n͠ga uppát	we four.

5. Between the complete forms of the demonstratives and substantives without a qualifying word, attributes or numbers. Examples:

daytóy a lakáy	this old man.
dagitóy a babaknán͠g	these rich men.
dagitá a natáyag	those tall ones.
dagidiáy n͠ga uppát	those four.

NOTE 2.—The ligature may be omitted in this case. Examples:

daytóy lakáy	this old man.
dagitá babaknán͠g	those rich men.
daydiáy natáyag	that tall one.
dagitáy duá	those two.
daydí ubín͠g	that child.

6. Between adjectives and adverbs, or vice versa. Examples:

nan͠gína a nalabés	too expensive.
napalálo a dakkél	too large.
pásig a nalukmég	all of them fat.
pulós a dákes	entirely bad.
kastóy a dakkél	as large as this.
nabaknán͠g a sígud	rich from the beginning.

7. Between some numbers. Examples:

uppát a púlo	forty.
siám a gasút	nine hundred.
inném a ríbu	six thousand.

8. Between predicates without a definite subject or indefinite substantives and substantival verbs. In this case, the substantival verb corresponds to an English infinitive. Examples:

nakaay-ayát a buyáen	it is lovable to look at it.
nakaladladín͠git a den͠ggén	it is sad to hear it.
nasam-ít a ramanán	it is sweet to the taste.
narígat a baonén	it is hard to send him.
naimbág a tun͠gpálen	it is good to comply with it.
nalaká a patién	it is easy to believe it.
dákes n͠ga inumén	it is bad to drink it.
nakaskasdáaw a kitkitáen	it is wonderful to behold.
táo n͠ga ayatén	a man to be loved.
lakáy a dayáwen	an old man to be honored.
annóng a tun͠gpálen	a duty to be complied with.
rebbén͠g a lualoén	one should recite the prayer.

9. Between predicates with a definite subject and verbs. In this case, the verb corresponds to an English present participle. Examples:

nasadútak a mamúnag	I am lazy in carrying.
nasiglát n͠ga agtaráy	he is a swift runner.
napigsákami a man͠gamít	we are strong bearers.
nalaingka n͠ga agsán͠git	you are good at weeping.
narugitda n͠ga aglúto	they are dirty cooks.
adúkami a man͠gán	we are many eaters.
bassítkayo a mapán	you are few to go.
nalakáda a lumakáy	they age easily.
nadarásyo n͠ga inála	you got it quick.
nalakáda a malipátan	they forget it easily.
narígatda a nabirókan	they found it with difficulty.
duáda n͠ga immáy	they came two of them.

10. Between substantival verbs and adjectival verbs with a definite subject. In this case, the adjectival verb corresponds to an English clause introduced by "that". Examples:

kayátko a pumánawda	I want them to go away.
ammok a mayátda	I know that they are willing.
ammóna a nagtaráyak	he knows that I ran.
nadámagda a nagtálawkami	they heard that we escaped.
ipalúbosda ñga umáykayo	they allow you to come.
dída tinañgdánan a nagbanbannóg	they gave him no salary when he worked till he was tired.
inpakaammóda a natáy ti asáwak	they announced the death of my husband.

11. Between two substantival verbs. In this case, the second verb corresponds to an English infinitive, or, if the subject of both verbs is not the same, to an English clause introduced by "that". Examples:

kayátmi ñga aláen	we want to take it.
ammóna a basáen	he knows how to read it.
inkarína a sinapataán	he promised under oath.
kayátda a kanén	they want to eat it.
tinulbekánna a niluktán	he opened it with the key.
ibílinmi a birókenyo	we order you to look for it.
ipalúbosda a sagádanmi	they allow us to sweep it (that we sweep it).
kayátko a balkótenda	I want them to wrap it up.
kinonána ñga inapúñgol ti kabsátna	he said embracing his brother.

12. Between adjectival verbs and substantival verbs. In this case, the substantival verb corresponds to an English present participle, or, if the subject of both verbs is not the same, to an English clause introduced by "that". Examples:

di sumuñgbát ñga ayabán	he does not answer when called.
di agtaliáw a pakisaoán	he does not look back when spoken to.
maitibkúlda a ginagára	they stumble on purpose.
kumugtár a sakayán	he kicks when mounted.
agsáñgit a baúten	he weeps when whipped.
madí a baonén	he refuses to be sent.
mayátda ñga aláenmi	they are willing that we take it.
madída a sagádanmi	they do not want us to sweep it.
di nagtímek a binúutda	he said nothing when they whipped him.

13. Between two adjectival verbs. In this case, the second verb corresponds to an English present participle, or, if the

subject of both verbs is not the same, to an English clause introduced by "that". Examples:

aggagétka ñga agádal	be diligent in studying.
aginàyadda a magná	they walk slowly.
agin-ínutda a pumídut	they steal a little at a time.
agpukpukkáwda a matmatúrog	they shout sleeping.
agsursúrat a mañgmañgán	he writes eating.
agbasbásaka a magmagná	you read walking.
madi a kumíta	he refuses to look.
mayátda ñga umáy	they are willing to come.
mayátda ñga umáykami	they are willing that we come.
madída a magnákami	they do not want us to walk.

14. Between *addá* with a definite subject and adjectival verbs. In this case, the verb corresponds to an English present participle. Examples:

addáak ñga umáy	I am coming.
addáda ñga agsursúrat	they are writing.
addá a matúrog	he is sleeping.
addákayo a mapán	are you going?

15. Between verbs and adverbs, or vice versa. Examples:

sígud a mayát	he has always been willing.
kankanáyon a madí	he always refuses.
madí a pulós	he doesn't want at all.
sagpaminsán ñga umáy	he comes now and then.
inaldáw ñga agsáñgit	he weeps every day.
matúrogda a patináyon	they always sleep.

16. Between the negative *saán* the the word it qualifies. Examples:

saán a dákes	it is not bad.
saán a táo	he is not a man.
saánda a talló	they are not three.
saán ñga umáy	he does not come.
saán a siák	not I.
saán a ni daytóy	not this one.
saánna ñga inála	he did not take it.
saánko a kayát	I don't like it.
saán a tapnó umáyka	not that you should come.

17. After a few conjunctions. Examples:

apáman a pimmánaw	he was scarcely gone.
isúna láeng ñga addá ditòy	the question is that it is here.
idínto a simmayáaten	while it had grown nicer already.

SECOND TABLE

The ligature *a* or *ñga* is omitted in the following cases, where the numbers in parentheses correspond to those of the preceding table:

1 (1). Between *apó* without a possessive and the noun it modifies. Examples:

ni apó lakáy	the old gentleman.
ni apó bakét	the old lady.
ni apó António	Mr. Anthony.
ni apó tesoréro	Mr. treasurer.

2 (1). Between a few common names of persons used without a possessive and their proper names. Examples:

ni amá Juán	father John.
ni lakáy António	the old Anthony.
ni bakét Ana	the old Ann.

3 (2). Between *tuñggál* or *tumuñggál* and the word it modifies. Examples:

tuñggál aldáw	every day.
tumuñggál dáras	each time.
sagtuñggál gasút	each one hundred.
tuñggál kadakayó	everyone of you.
tumuñggál aramídenda	every time they do it.
tumuñggál agsárakkami	every time we meet.
tuñggál kalpasán ti dáwat	after each asking.
tumuñggál baliksénna dagitòy a saò	every time he pronounces these words.
tuñggál dáwat	every asking.
tuñggál malagípkayo	every time I remember you.

4 (3). Between numbers ending in a vowel and some substantives. Examples:

limá salapí	two pesos fifty.
dua salúp	two gantas.
talló bukél ñga itlóg	three eggs.
sañgapúlo ket duá kuríbut	twelve baskets.

5 (5). Between the abbreviated forms of the demonstratives and substantives, attributes and numbers. Examples:

di lakáy	that old man.
toy áso	this dog.
toy dakkél	this large one.
diáy bassít	that small one.
tay uppát	those four.
ta limá	those five.

NOTE 3.—In a few cases the ligature may be used. Examples:

toy a baláy	this house.
diáy a dakkél	that large one.

6 (5). Between the complete forms of the demonstratives and substantives connected with attributes or numbers. Examples:

daytóy dakkél ñga áso	this large dog.
daydiáy lakáy a bulsék	that blind old man.
daydí bassít ñga ubíñg	that small child.
dagitóy duá a babái	these two women.
dagidiáy natañgsít a baró	those proud young men.
dagidí talló a lalláki	those three men.
dagitáy ubbíñg ñga úmel	those dumb children.

7 (6). Between adjectives and adverbs, or vice versa. Examples:

dakkél únay	very large.
bassít láeñg	only little.
iñggét sam-ít	very sweet.
adú pay	many more.
dáan met	it's old though.

8 (7). Between some numbers. Examples:

talló púlo	thirty.
waló púlo	eighty.
duá gasút	two hundred.
limá ríbu	five thousand

9 (13). Between the auxiliaries *in, mapán* and *umáy*, and the principal verb. In this case the verb corresponds to an English infinitive. Examples:

ínna biróken	he goes to look for it.
ínkam sapliten	we go to whip him.
napán nañgála	he went to take some.
napányo ginátañg	did you go to buy it?
umáyda mañgán	they come to eat.
immáy kimmíta	he came to see.

10 (14). Between *addá* without a definite subject and adjectival verbs. Examples:

addá umáy	somebody comes.
addá madí	some refuse.
addá mañgála	someone takes it.
addá mayát	some are willing.

11 (15). Between verbs and adverbs, or vice versa. Examples:

madí láeñg	he still refuses.
kayátna únay	he wants it badly.

pagamodán sumañgpét	he arrives at once.
mapán itá	he goes now.
agnaéd ditóy	he lives here.
umáyka darás	come quickly.
ínka biít	go for a while.

12 (16). Between the negative *di* and the word it modifies. Examples:

díak kayát	I won't.
dída aláen	they do not take it.
díkam masápul	we don't need it.
díka agtákaw	don't steal.

13 (17). In general, when an article, a conjunction, another ligature, and so on, connects the words. Examples:

addá ti táo	that man is there.
dakkél ti áso	the dog is big.
napán itáy malém	he went this afternoon.
umáy no bigát	he comes to-morrow.
siák ti madí	it is I who refuse.
ibagám ta umáy	tell him to come.
inpánna idiáy baláy	he carried it into the house.

II. THE LIGATURE *TI*

A. The ligature *ti* translates the English relative pronoun whenever the subject of a predicate or of an adjectival verb, the object of a substantival verb, an adverb, and so on, is emphasized and precedes all other members of the sentence. Cfr. The Pronoun. IV. Relative Pronouns. II[3]. Examples:

siák ti natáyag	I am the tall one.
siák ti pagsurátanda	I am the one to whom they write.
ti anákmo ti nalukméy	it is your child who is fat.
idiáy baláy ti pagsañgitanna	he weeps in the house.
dagití tálonmo ti naláwa	your rice fields are the large ones.
ti panagsáñgityo ti napigsá	your weeping is what is strong.
ti áso ti awán	it is the dog which is not there.
baláy ti awán kaniák	houses are what I have not.
isúda ti addá	they are those who are there.
ti aginádyad ti kayátda	they want to do it slowly.
isú ti madí	he it is who refuses.
ni Juán ti agsáñgit	it is John who weeps.
dakayó ti napúdot ti ólona	you are those who are angry.
dakamí ti mapán	it is we who go.
asín ti gatáñgenmi	salt it what we buy.
ti lakáy ti sapúlenna	the old man is the one he looks for.
isúda ti kayátko	them I like.

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[3] Anthropos 28 (1933) 701.

B. *Ti* is used as a ligature in the following cases:

THIRD TABLE

The numbers in parentheses correspond to those of the first table, under the ligature *a* or *ñg̃a*.

1 (2). Between *ámin* meaning "the whole" and the word it modifies. Examples:

ámin ti lúboñg̃	the whole world.
ámin ti íli	the whole town.
ámin ti baláymi	our whole house.
ámin ti bagína	his entire body.

2 (9). Between predicates without a definite subject and adjectival verbs. In this case, the verb corresponds to an English infinitive. Examples:

narígat ti agkáli	it is difficult to dig.
nakaay-ayát ti makakíta kadakayó	it is lovable to see you.
nalaká ti agsaó	it is easy to talk.
naimbág ti agluálo	it is good to pray.
dákes ti agbásol	it is bad to sin.
naímas ti mañg̃án no mabisín datáo	it is sweet to eat when one is hungry.
nakaladladíñg̃it ti agsína ití gayyém	it is sad to separate from a friend.
nakaragragsák ti sumañg̃pét idiáy baláy	it is joyful to come home.

3 (10). Between substantival verbs and adjectival verbs without a definite subject. In this case, the adjectival verb corresponds to an English infinitive. Examples:

kayátko ti mapán	I want to go.
kayátda ti agtugáw	they want to sit.
ammóna ti agbása	he knows how to read.
ipalúbosmi ti agkatáwa	we allow laughing.
inkaríyo ti agbáyad	you promised to pay.
darasényo ti mapán	go quickly.
inayádenyo ti agálad	make the fence slowly.
sansánenda ti agluálo	they pray often.

4 (14). Between *awán* and its indefinite subject, except when the ligature *ti* precedes it, in which case the second one is generally omitted, as well as in a few other cases which have to be learned by use. Examples:

awán ti táo	no man is here.
awán ti umáy	nobody comes.
awán ti áso kadakuáda	they have no dog.
awán ti aláenda	they take nothing.

awán ti baláymi	we have no house.
awán ti insañĝpétda	they brought nothing.
awán ti birókenyo	don't you look for anything?
siák ti awán bagásna	I am the one who has no rice.
awán sabáli	nothing else.

NOTE 4.—Sometimes the ligature *ti* becomes *t* when it follows a word ending in a vowel. Examples:

isút mayát	he it is who likes it.
dakamít mapán	we shall go.
isúdat madí	they are those who refuse.

5. The ligature *ití* sometimes replaces the ligature *a* or *ñĝa* between substantival verbs in literature; this form, which is probably incorrect, never occurs in speech and rarely in literature. Examples:

dawátek ití isalákannak	I ask you to save me.

III. THE LIGATURE *TA*

1. This ligature takes the place of *a* or *ñĝa* after the substantival verb *ibagá*. Examples:

ibagám ta umáy	tell him to come.

2. The ligature *ta* is sometimes used after conjunctions. Examples:

idínto ta saánmo a makíta	while you don't see him.
anansá ta ibagák kadakayó	therefore I tell you.
agsípud ta immáy	because he came.
di la ket mamin-anó ta agsáñĝit	lest he weep.
sápay komá ta mayát	I wish he were willing.
idí ta limmábas idiáy	when he passed there.

IV. THE LIGATURE *N*

The ligature *n* is used:

1. To connect the adverbs *to* and *sa* to words ending in a vowel. Examples:

addánto	there will be some.
walónto	there will be eight.
tínto mayát	the one who shall be willing.
aramidendanto	they will do it.
sánto umáy	then he comes.
inálananaa	he probably took it.
madínsa	I think he refuses.
isúdantonsa ti madí	probably they will be those who refuse.
isúnsa ti nagsáñĝit	he is probably the one who wept.

2. Sometimes to connect the stem to the reduplication of the first two syllables, when the last one ends in a vowel; if the last syllable of the reduplication ends in a consonant, the ligature *n* sometimes takes the place of that consonant. Examples:

agkitankítada	they look at one another.
aglinniwanliwáta	let us console one another.
agkarinkaríkayo	you promise one another.
agayanayátda	they love one another.
nagsuransúratkami	we wrote to one another.
nakidubandúbarda	they tried to overcome one another.

V. THE LIGATURE *KA*

1. The ligature *ka* may be used between cardinal numbers from two up and some substantives. Examples:

talló katáo	three men.
sañgagasút a kasúkat	one hundred measures.
waló kakíta	eight kinds.

2. The ligature *ka* is very often combined with the prefix *sañga* into *sañgka,* to form a prefix for units or unity. Examples:

sañgkaígup	one draught of water.
sañgkapetpét	one handful.
sañgkagiddán	in one; together.
sañgkarañgkáy	one piece (of meat).

VI. THE LIGATURE *T*

1. The ligature *t* is not much used in speech, but it occurs frequently in literature, where it is often joined to a word ending in a vowel. It is almost impossible to give any definite rules for the use of this ligature, as sometimes it is used and sometimes not in the same combination; consequently its use is more or less arbitrary. However, it is mostly met before adverbs or prepositions of time and place, in a few cases even replacing them. It should be noted here that some Iloko authors consider its use in some of the following examples (taken from Iloko books) entirely incorrect. Examples:

gapót ití dakkél ñga ayátna	because of his great love.
nagtaklíndat ití panañgibábaet ti lakáy	they relied on the mediation of the old man.
dakdakkél lat bassít ñgem daytóy	it is only a little larger than this one.
pakipaglak-ámanmit ití imbág	where we partake of the same good.
napándat sadí abagátan	they went south.
immúlit sadí láñgit	he ascended into heaven.
awándat ditóy	they are not here.
kaykayátmot idí	formerly you preferred it.

agsublíkat sadí Maníla	go back to Manila.
kúkuat ditoy lúboñg	earthly goods.
a kas lat itáy	just like a while ago.
addát ditá	he is there.
intanémdat ditá	they interred him there.
ínnaktot Maníla	I shall go to Manila.
mapánkamit Bintár	we go to Bintar.

NOTE 6.—The ligature *t* must not be confounded with the abbreviation of *ti* or *ití*. Examples:

aniát gapóna	why?
aniántot mabalínna	what shall he be able to do?
nagpaidúmat siñgpét	full of virtues; extraordinarily virtuous.
nópay kasanót ulímekna	howsoever he keep silent.

2. The ligature *t* is nearly always used between a word ending in a vowel and:

a. The adverbs of place *ta*, *toy* and *diáy*. Examples:

ínkat ta	go there.
addát ta	he is there.
nagsakítak idít ta	I was ill there before.
umáykat toy	come here.
awándantot toy	they will not be here.
napándat diáy	they went there.
agsublíkamit diáy	we go back there.

b. The abbreviated forms of the demonstratives in the nominative. Examples:

inálanat toy ásomi	he took our dog here.
saán a makakutí toy ímak	this hand of mine cannot move.
inaládannat ta baláyyo	he fenced that house of yours.
aláennat diáy púsami	he takes that cat of ours.
kasanót tay inám	how is that mother of yours?
binásadat tay súratko	they read that letter of mine.
aniát di kinayátna	what did he want?

c. The abbreviated forms of the demonstratives in the oblique, when their initial *i* is dropped. Examples:

saludsúdendat toy ubíñgmi	they ask this boy of ours about it.
inbátinat ta baláyyo	he left it in that house of yours.
inbagámit ta amán	we told it to that father of yours.
makakítakamit diáy íliyo	we can see that town of yours.
nagsublít tay napanáwanna a baláy	he went back to that house he had left.
umáykayot di nagyanánmi	you will come to where we stayed.

d. The adverbs of time *itá*, *itáy* and *idí*, when their initial *i* is dropped. Examples:

umáydat ta	they come now.
ipakaammómit ta	we announced it now.
itattá (for: *itaitá*)	presently.
nagsublíkamit tay	we returned just now.
itattáy (for: *itaitáy*)	just a while ago.
madídat tay	they refused just now.
inbagáyot di	you said so at the time.
inálanat di	he took it then.

3. The ligature *t* is used ordinarily after the prepositions or conjunctions *iñggá, iñggána, agiñgga, agiñggána.* Examples:

iñggat malém	until afternoon.
iñggát día maasáas	until he has learned it thoroughly.
iñggánat tuñgpál biágko	till the end of my life.
iñggánat ití díka natáy	until you die.
iñggánat ti saán a nalúto	until it is cooked.
iñggánat mabalínko	with all my might.
iñggánat aggíbus toy biág	until the end of this life.
iñggánat kabaelán	with all one's might.
iñggánat ití mabayádan ámin	till everything has been paid.
agiñggát masañgoánan	until the future.
agiñggát mabayádan ámin	till you have paid everything.
agiñggánat itá	till now.

Chapter II: THE CONJUNCTION

I. THE CONJUNCTION "AND"

I. The conjunction "and" is represented in Iloko by *ken* and *ket.*

1. *Ken* is used to connect two words or sentences which form a whole through their connection with another term either preceding or following, and which consequently cannot be separated without affecting their meaning.

2. *Ket* is used to connect two words or sentences which are entirely independent from any other term, so that either of them can be used separately without affecting their meaning.

A. *ti naluknéñg ken naímas a tinápay,* "the soft and sweet bread". The two qualifications form a whole through their connection with the substantive; if they were used without any connecting conjunction, they would refer to two different objects: *ti naluknéñg,* "the soft one"; *ti naímas a tinápay,* "the sweet bread"; therefore they are connected by *ken.*

B. *ni Ana babái ket ubiñg,* "Ann, a girl and a child". The two predicates are entirely independent and could easily be used separately; *ni Ana babái* would mean "Ann, a girl"; *ubiñg,* "she is a child"; therefore they are connected by *ket.*

C. *siká ñga apók, mañgituróñg, mañgikanáwa ken masírib a mamatigmáan kaniák, ket naimbág únay a gayyémko,* "you, my master, the one who guides, guards and wisely advises me, and my very good friend. Here are three independent predicates: a. *apók;* b. *mañgituroñg, mañgikanáwa ken masírib a mamatigmáan kaniák;* c. *naimbág únay a gayyémko;* each of them could be used separately: a. my master; b. the one who guides, guards and wisely advises me; c. my very good friend; therefore they are connected by *ket.* The second qualificative is a triple one and each part depends on the term *kaniák* (me); therefore they are connected by *ken;* if each part stood alone, they would not have the same meaning: *ti mañgituróng,* "the one who guides somebody"; *ti mañgikanáwa,* "the one who guards somebody"; *ti masírib a mamatigmáan kaniák,* "the one who wisely advises me".

D. *agmalmalém ken agpatnágka,* "you stay the whole day and night". If separated, these terms would mean: he stays the whole day, you stay the whole night; therefore *ken* is used.

E. *ayatén ken taraknénda idá,* "they love and feed them". If separated, these two terms would mean: to love (them), they feed them; therefore *ken* is used.

F. *agtaéñg ditoy ket kankanáyon a tuloñgannakami,* "he resides here and always help us". These two sentences could easily be used separately: he resides here, he always helps us; therefore *ket* is used.

G. *aniá ti addá idiáy?—áso ken púsa,* "what is there?—a dog and a cat". Both substantives *áso* and *púsa* depend on the term *addá* (expressed or understood). If they were separated or connected with one another by *ket,* the sentence would mean: there is a dog (and) it is a cat; therefore *ken* is used. Examples:

ti lúpot a napígis ken narugitán	the torn and dirtied cloth.
tapnó nalaglagdáda pay ken nanayndáyonda	so that they be still stronger and of longer duration.
dagiti kakabagián ken amammóna	his relatives and acquaintances.
ti pagimbagán ti kararuá ken bagí	the good of soul and body.
isúna la a dawátek ken kayátko ti túlongmo	but I beg and desire your help.
saoénna a nailét ti roáñgan ken no kasanó ti panagbiágta	he says that the door is narrow and how we have to live.
sibubutéñg ken mamayegpégak	I am full of fear and I tremble.
addáda a sililidáy ken agsangsáñgit	they are sad and weeping.

nagtagikampilan ken nagtagipan͠g-órkayo n͠ga immáy	you came carrying swords and clubs.
ti nan͠gn͠gég ken nakitayo	what you heard and saw.
ti amána a bulsék ken masaksakit	his blind and sick father.
isú ti asín ken sílaw ti lúbon͠g	he is the salt and light of the world.
nagsagába kadagití nakáro a túok ken ran͠ggás	he suffered intense tortures and injuries.
táo n͠ga agdindinámag iti kinapakumbabá ken kinamanákem	a man renowned for humility and sense.
tapnó madaydáyawka iti isú amín a yan ken iti isú ámin a táo	so that you be honored in all places and by all men.
san͠gapúlo ket duá	twelve.
talló gasút ket uppát a púlo	three hundred forty.
kayát ti lakáy ket mayátak met	the old man is willing and I also.
ikkánnak ti pirák ket aramídem n͠ga awán ti kúran͠gko	give me money and make that I want nothing.
siká ti pagtaklínanmi ket dawátenmi ti túlongmo	we rely on you and we ask your help.
isalákannakami ket irámanmo dagití kakabsátmi	save us and do the same to our brothers.
agpatnágka ditóy ket uráyennak	stay here all night and wait for me.
kablaáwanka ket kayátko a kablaáwan dagití gayyémmo	I salute you and I want to salute your friends.
makisaóka kenkuána ket panunótem ti ayátna kenká	talk with him and think about his love for you.
díka maituréd ket awán ti bílegmo	you cannot stand it and you have no strength.
tulón͠gam idá ket kaasiánnakami	help them and have pity on us.
ti nákemko maáwis ket matignáy	my will is attracted and touched.
badán͠gannak ket iturón͠gnak iti nalintég a dálan	help me and lead me on the right way.
manípud iti duá a tawén ket agpababá	from two years down.
tinúloyna ti nagná ket kinonána iti nákemna	he continued walking and thought by himself.
ket ti agáni umáwat iti báyad ket agornón͠g iti búnga	and the reapers receive the price and gather the fruits.
maysá ti agmúla ket sabáli ti agáni	one man sows and another one reaps.
isúrom kenkúána ti pudnó ket yadayóm kenkuána dagití isú ámin a sipn͠gét ti kinanen͠gnén͠g	teach him the truth and drive away from him all darkness and ignorance.

NOTE 7.—If there are more than two words or sentences to be connected with one another, the conjunction is ordinarily used only between the last two. Examples:

ti áso a nañgísit, dakkél ken nakottóñg	the black, large and thin dog.
tuládek ti panañgumsína ití bagína met láeng ken ití lúboñg, ti panañgparparígatna kadagití gartém, ti kinapakúrañg ken ti kinadalús ti nákem	I imitate his contempt of self and of the world, his mortification of the passions, the humility and the purity of the mind.
ti áso a nañgísit dakkél, nakottóñg ket atiddág ti ípusna	the black dog is large, thin and has a long tail.
ni Juán manákem a táo, masírib ket nasiñgpét	John is a sensible man, wise and virtuous.
kadagití saóna a kásda la natarumámis a pána salpótenna dagití púso dagití tattáo ket maáwisna ñga agkabláaw kenkuána ti umatiwekwék a tattáo, ket iturayanna dagití ar-ári, pakigtótenna dagití babaknáñg, parmekénna dagití gagayyémna ket pasurótenna ití nákemna dagití isú ámin ñga il-íli	by his words, like sharp arrows, he pierces the hearts of men and makes great numbers of people salute him, and rules over kings, startles the rich, vanquishes his enemies, consoles his friends and makes all peoples obey his will.

8. To connect two substantives in the plural, *káda* is sometimes used instead of *ken,* with the meaning of indefiniteness. Examples:

balbaláy káda taltálon	houses and rice fields.
dagití lallakáy káda babbakét	old men and women.
rineppétda ití talí káda káwar	they bound him with ropes and chains.
babbalásañg káda babbaró	girls and young men.

II. When a series of terms is introduced by a personal pronoun in the singular, a proper name or a common name (allowing the article *ni*) in the singular:

A. The ordinary conjunction *ken* may be used to connect the last two terms of the sentence. Examples:

ni Luís ken ni Ana	Lewis and Ann.
siák ken ni Luís	I and Lewis.
ni áma ken ni Luís	my father and Lewis.
ni inám ken dagití kakabsátmo	your mother and your brothers.
dayáwem ni amám ken ni inám	honor thy father and mother.
siák, ni Luís ken ni Ana	I, Lewis and Ann.

ni Luís, ni Ana ken ni Pédro	Lewis, Ann and Peter.
ni kabsátko, ni gayyémko ken ni ulitégko	my brother, my friend and my uncle.

B. The more elegant and perhaps the more correct way is:

1. To use the form of the nominative plural for the first term, the form of the oblique plural for the intermediary ones, and the form of the oblique singular for the last term, except:

a. When the terms are in the plural, in which case the form *kadagití* has to be used at least with the term which follows immediately a term with *da* or *káda;*

b. When the terms do not allow the article *ni,* in which case the form *ití* has to be used at least with the term which follows immediately a term with *da* or *káda.* Examples:

GENERAL RULE

da Luís ken María	Lewis and Mary.
dakamí ken Luís	I and Lewis.
isúda ken María	she and Mary.
dakayó ken Juán	you and John.
da áma ken kabsátko	my father and my brother.
da Luís káda Ana káda Pédro ken María	Lewis, Ann, Peter and Mary.
dakamí káda Luís ken Ana	I, Lewis and Ann.
da gayyémko káda Luís ken Ana	my friend, Lewis and Ann.
daytá ti púsa da Luís ken Ana	that is the cat of Lewis and Ann.
ti baláyyo ken Ana	the house of you and Ann.
daytóy ti ásoda ken gayyémna	this is the dog of him and his friend.

EXCEPTIONS (a)

da Luís kadagití allawági ken gayyémna	Lewis and the carpenters and his friends.
da Luís kadagití kakabsátna	Lewis and his brothers.
dakamí kadagití allawági	I and the carpenters.
da ulitégko kadagití allawági	my uncle and the carpenters.
da áma kadagití gayyémko ken am-ammók	my father, my friends and acquaintances.
da áma kadagití allawági ken gayyémna	my father, the carpenters and his friends.
da Pédro káda áma kadagití kakabsátko	Peter, my father and my brothers.
da Luís káda Pédro kadagití kakabsátmi ken am-ammómi	Lewis, Peter, our brothers and acquaintances.

EXCEPTIONS (b)

da Luís ití allawági	Lewis and the carpenter.
dakayó ití allawági	you and the carpenter.
isúda ití allawági	he and the carpenter.
da Luís ití allawági ken ti am-ammóna	Lewis, the carpenter and his acquaintance.

dakayó káda gayyémko iti allawági	you, my friend and the carpenter.
da Luís káda María iti allawági	Lewis, Mary and the carpenter.
da Pédro káda Ana iti allawági ken ti kosinéro	Peter, Ann, the carpenter and the cook.

2. That is the rule for the nominative and the genitive; but, if the series is in the oblique, all forms must be in the oblique. Examples:

yáwatmo káda Luís ken María	give it to Lewis and Mary.
yáwatmo káda Luís káda Ana káda Pédro ken María	give it to Lewis, to Ann, to Peter and to Mary.
yáwatko kadakayó ken María	I give it to you and Mary.
ipánmo káda áma ken María	carry it to my father and to Mary.
inálak káda ulitégko káda María ken asáwana	I took it from my uncle, from Mary and from her husband.
yáwatmo káda Luís kadagiti kakabsátna	give it to Lewis and to his brothers.
yáwatmo káda Luís kadagití allawági ken gayyémna	give it to Lewis, to the carpenters and to his friends.
inálak káda ulitégko kadagití kakabsátko ken am-ammók	I took it from my uncle, from my brothers and from my acquaintances.
yáwatmo káda Luís iti allawági	give it to Lewis and to the carpenter.
yáwatmo káda Luís iti allawági ken iti am-ammóna	give it to Lewis, to the carpenter and to his acquaintance.
ginátangko káda Ana iti allawági ken iti am-ammóna	I bought it from Ann, from the carpenter and from his acquaintance.

NOTE 9.—The same forms may be used when a demonstrative pronoun in the singular (in English) or a common name in the plural introduces the sentence, provided that proper names or common names with *ni* are included in the series. Examples:

dagitóy ken Ana	this one and Ann.
dagidiáy káda Ana ken Luís	that one and Ann and Lewis.
dagitáy káda áma ken Luís	that one and my father and Lewis.
dagitá káda gayyémko ken Ana	that one and my friend and Ann.
dagitóy ken Pédro	this one and Peter.
dagitá ken Ana	that one and Ann.
dagití kakabsátko ken Luís	my brothers and Lewis.
dagití allawági káda António ken Ana	the carpenters, Anthony and Ann.
dagití kaaróbami káda gayyémmi ken Luís	our neighbors, our friends and Lewis.

10. When a personal pronoun enters the series, it should be placed first. Examples:

dakamí ken Juán	I and John.
dakamí káda Luís kadagití gayyémko	I, Lewis and my friends.

dakayó kadagitóy	you and these ones.
isúda iti allawági	he and the carpenter.

11. If the first term is a personal pronoun or a demonstrative in the plural, the ordinary conjunction *ken* connects at least the last two terms of the series. Examples:

dakamí ken ni Juán	we and John.
dakayó ken ni António	you and Anthony.
dakayó, ni Ana ken ni Luís	you, Ann and Lewis.
dagitóy ken ni áma	these ones and my father.
dagidiáy ken ni kabsátko	those ones and my brother.
dagitáy, ni Ana ken ni kabsátko	those ones, Ann and my brother.

II. THE CONJUNCTION "OR"

I. The conjunction "or" is represented in Iloko by *ken* and *wennó or annó.*

1. *Ken* is used occasionally to connect two words or sentences which are entirely independent from any other term, so that either of them can be used separately without affecting their meaning.

The difference between the disjunctive and the copulative *ken* may best be illustrated by the following examples:

> *addá áso ken púsa,* "there is a dog and a cat"; both terms depend on *addá* (*ken* copulative);
>
> *áso ken púsa aláem,* "dog or cat, take it"; both terms are independent predicates: *áso, púsa, aláem,* "it is a dog, it is a cat, take it"; therefore *ken* is disjunctive. If the conjunction were a copulative, *ket* should be used, and the sentence would have an impossible meaning: *áso ket púsa,* "it is a dog and it is a cat".
>
> *agsañg̃it ken agkatáwa makaammó,* "he weeps or he laughs, it is his business". If the conjunction were a copulative, *ket* should be used, because the predicates are independent from any other term: *agsañg̃it ket agkatáwa,* "he weeps and laughs". Examples:

kayát man ken saán dagití ubiñg̃	whether the children like it or not.
umáy man ken saán	whether he comes or not.
addá pirákna ken awán	whether he has money or not.
napúdot ken nalamíis adín ti yánna	cold or warm, where is it?
nakersáñg̃ ken nalínis gatáñg̃em	rough or smooth, buy it.
addá man inálana ken awán	whether he took some or not.

2. *Wennó* or *annó* is of general use; *wennó*, however, is more commonly used than *annó*. Examples:

díak ammó no baró wennó lakáy	I don't know whether he is young or old.
maminsán wennó mamindua	once or twice.
agtaráyka wennó no saán a mabalín darasém ti magná	run or, if it is impossible, walk fast.
saánmo a baybay-án ti matúrog wennó aginaná	do not quit sleeping or resting.
ití nasurók a talló wennó uppát ñga aldáw	over three or four days.
narugít man wennó saán	whether dirty or not.
aniá ti kayátmo, áso wennó púsa	what do you like, a dog or a cat?
mapánka wennó madíka	do you go or do you refuse?
ni Pédro ti ayabányo annó ni Juán	call Peter or John.

II. "Either, whether. . . or" is sometimes expressed by *wennó* or *úray* repeated. Examples:

wennó aramídem wennó patayénka	either you do it or I kill you.
wennó agnaéd ditóy sa agnákem wennó agáwid idiáy baláyna	he either stays here and is sensible or goes back home.
uray naimbág úray dákes	whether good or bad.
úray mayátka úray madíka	whether you are willing or not.
úray agsublíka ditóy úray mapánka idiáy ílim konána	he says that you either come back here or go to your town.
kayátko ti gumátañg úray nañgína úray nalaká	I want to buy whether dear or cheap.

NOTE 12.—In some adverbial expressions the conjunctions "and" and "or" are omitted in Iloko. Examples:

sumurók kumúrang	more or less.
ti bumabá ñgumáto a gurígur	the fever that goes up and down.
bigát kasañgaaldáw madadáel	it will be ruined in a couple of days; literally: morrow next day it is ruined.

III. THE CONJUNCTION "BUT"

I. The conjunction "but" is represented in Iloko by the adverbs *ket, ketdí, met,* and so on, and by the conjunction *ñgem.*

1. The adverbs have been explained. Cfr. The Adverb. VIII. Other Adverbs. II[4]. Examples:

isalákannakam ket ití dákes	but deliver us from evil.
inarámidda ket kenkuána dágup ti kinayátda	but they treated him howsoever they liked.
awán met	but there is nothing.
addá ketdí	but he is here.

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[4] Phil. Jour. Sci. 75 (1941) 197–225.

2. *Ñgem is the ordinary conjunction.* Examples:

aláek komá ñgem awán ti táo	I should take it, but there is nobody.
konák a nasiñgpét ñgem adú ti dákes a kadawiánna	I thought he was virtuous, but he has many bad habits.
ñgem díka inarámid gapó ití ayátmo kaniák	but you didn't do it because you love me.
natan-ókda únay idí ñgem nagbalinda a dákes	formerly they were of very high standing, but they became bad.
ñgem saán a maitéd daytóy no awán ti kaikarián kenkuána	but this will not be given if he has no merits.
nagbírok ñgem awán	he looked for some, but there was nothing.
ínka ñgarúd ñgem díka agbarték	go, all right, but don't get drunk.
madída ti agádal ñgem kayátda ti agay-áyam	they don't want to learn, but they like to play.
awándat toy ñgem mabalín ñga addáda idiáy	they are not here, but perhaps they are there.
madíak komá ñgem napának met láeñgen	I wanted to refuse, but I went anyhow.

NOTE 13.—*Ngem also translates* "than", introducing the second member of a comparison. Cfr. The Adjective. II. Comparatives and Superlatives[5], Examples:

dakdakkél ñgem daytóy	it is larger than this.
naim-ímas ti inapúy ñgem ti tinápay	rice is more savory than bread.
nadardarás ñgem isú	he is faster than he.

NOTE 14.—*Em,* an equivalent *ñgem,* has become obsolete; formerly it was generally preferred when following a word ending in a consonant. Examples:

aramidem em dika sumubli ditoyen	do it, but don't come back here

II. After a negative or an interrogative sentence, the conjunction "but", which in English very often includes the concept of "except", is rendered into Iloko by:

1. *No saán* and *no saán lá(eñg)*. Examples:

saának ñga immáy nañgayáb kadagití nasiñgpét no saán ketdí a kadagití managbásol	I did not come to call the virtuous, but the sinners.
saán a ti nákemko ti matuñgpál no saán ket a ti nákemmo	not my will be done, but your will.
saán a dagitá no saán ket a dagitóy ti kayátko	not those but these I like.
saán a kas ití kayátko no saán ket a kas ití pagayatám	not as I will, but as you prefer it.
saán láeñg kadagití nañgáto no saán pay met kadagití nababá	not only for the high ones, but also for the low ones.

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[5] Anthropos 26 (1931) 477.

awán no saán a dagití táo a napanĝláw	there is nobody except the poor.
si asíno ti mayát no saán a ti addá pirákna	who is willing except he who has money?
awán met ti kagúrak no saán la a ti lakáy	I don't hate anybody except the old man.

2. *No di* and *no di ket no.* Examples:

saán a ti baláy ni Luís no di ti tálonna	it is not Lewis' house but his rice field.
saán a kadagití saó ng̃a isúro ti gayyém no di ití isúro ti amá	not by the words a friend teaches, but by what a father teaches.
awánto kenkuána ti pakawán no dínto ketdí madúsa	there will be no forgiveness for him, but he will rather be punished.
awán ti makaammó no di ti gayyémna	nobody knows except his friend.
awán sabáli no di ti inapúy	there is nothing else but rice.
awán ti ammóda no di ket isúna láeng a nasiñg̃pétda	they know nothing, but they are virtuous though.
awán komá ti makaammó no di ti amám	nobody should know except your father.
díka aláen no di ket no siká mang̃tédka	do not take except you give something.

NOTE 15.—*Isúna lá(eng̃)*, followed by the ligature *a* or *ng̃a*, means "but the question is that, were it not that," and so on. Examples:

isúna láeng̃ ng̃a addá ditóy	the question is that it is here.
dákesda isúna láeng̃ a nabuniáganda	they are bad, but they are baptized though.
isúna la ketdí a madláwko ti kaawánna	the question is though that I notice his absence.
kayátko komá a gatáng̃en isúna láeng̃ ng̃a awán ti pirákko	I should like to buy it were it not that I have no money.

V. THE CONJUNCTION "IF"

This conjunction is rendered into Iloko by:

1. *No.* Examples:

ikkánkanto no umáyka	I shall give you some if you come.
ibagám no addá ni Luís	tell me if Lewis is there.
no addá agkatáwa, no awán agsáng̃it	if there is some, he laughs, if there is not, he weeps.
no awán ng̃a agpaysó inka gumátang̃	if there is nothing really, go and buy.
no sumang̃pét nasayáat, no saán kastá met	if he comes home, all right, if he doesn't, all right also.
no madí saplítem (or) *saplítem no madí*	if he refuses, whip him.

NOTE 16.—The essential meaning of this conjunction is the conditional "if", but it really serves so many purposes that it might be called a con-

junction-ligature. Besides the examples which have been given under the adverbs of interrogation and under the preceding conjunction, and those that will be given under the following conjunctions, we shall add here a few characteristic ones. Examples:

kásna ibutéñg̃ no addá makadláw	he seems to be afraid that somebody notice it.
no awán met	well, there is nothing.
no isú ti inbagák	well, that is what I told you.
no maminsán nasayáat	it is good in a way.
no daddúma madí	sometimes he refuses.

2. *Intóno* (ordinary form), *tóno, attóno, antóno.* Cfr. The conjunction "lest" and The conjunction of time. Examples:

intóno madí ñg̃ay	what if he doesn't like it?
intóno awán aniánto ti aramídem	if there is nothing, what will you do?
intóno makasañg̃pét inka pay láeñg̃	if he arrives, will you still go?
intóno agsáñg̃it madíka ñg̃atá	if he weeps, perhaps you won't.

3. *Intó ñg̃arúd no* (ordinary form), *attó ñg̃arúd no, antó ñg̃arúd no.* Examples:

intó ñg̃arúd no mayát agsublíka	if he is willing, then you will come back.
intó ñg̃arúd no umáy ipalúbosmon	if he comes, will you allow it then?
intó ñg̃arúd no awán ananoém	if there is nothing, what will you do?

4. *No man no, no kas, no kas no* and *ñg̃áman no.* Examples:

no man no mapettát a matáy	if he dies suddenly.
no man no saánna ñg̃a annugóten	if he does not consent.
no kas didanto la masapúlanen	if they don't find it at all.
no kas addá báreñg̃ aniá	if something happens.
no kas no siák ti agturáy	if I were the ruler.
no kas no awán ti pirákko	if I had no money.
amañg̃an no addá sabáli ñg̃a ipañg̃pañg̃rónam	if you prefer somebody else?

5. *No komá no* and *no . . . komá,* introducing a conditional clause. Cfr. The Verb. Moods and Tenses. V[6].

V. THE CONJUNCTION "BECAUSE"

I. A. The most used Iloko conjunctions representing the English "because, as", and so on, are:

1. *Ta.* Examples:

díka agtákaw ta dákes	do not steal, as it is bad.
inarámidko daytá ta inbílinda	I did that because they told me to so.

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[6] Philip. Jour. Sci. 75 (1941) 200.

umáyak ta kayátko ti uminúm	I come because I want to drink.
addá komá umáy ta adú ti kanén	I wish somebody would come, as there is much food.
ití mabiít agsublínto ta nabirókanna ti napúkawna	he will be back soon, as he found what he lost.
dayáwentayo ta kastá ti rebbéñgna	let us honor him, because that is what should be done.
umis-ísem ti ubíñg ta addá abalbaláyna	the child smiles because it has a toy.
nasiñgpétda ta inaldáw agluáloda	they are virtuous because they pray every day.

NOTE 17.—*Ta* is a kind of general conjunction used very extensively in Iloko; it enters the composition of a great many complex conjunctions and, as a simple conjunction, it may represent the English "because, lest, that, so that", and so on. Cfr. also The Ligature *ta*. Examples:

díka ikastá ta báútennakanto	do not act that way lest he whip you.
aluádam ta aguñgét ti lakáy	be careful lest the old man be angry.
díka pidpiduáen ta masaplítka	don't do it again lest you be whipped.
kitáem ta tuñgpalem	see that you comply with it.
íntayo ta mañgántayo	let us go so that we eat.
umáyka ta agságadka toy	come and sweep here.
ínkayo ta agsúratkayo	go and write.

2. *Gapò ta.* Examples:

madí kanó gapó ta awán ti intédyo a gongonána	they say that he refuses, because you gave him no remuneration.
masansán ñga umáy ditóy gapó ta isú ti kayátna	he often comes here, because that is what he likes.
gapó ta dagitóy ñga aldáw naidátonda a pakadaydayáwanna	because these days are consecrated to his veneration.
díak kayát a gatáñgen gapó ta díak ammó no mabayagakto ditóy	I don't want to buy it, because I don't know if I shall stay here long.
nagtálaw ni Luis gapó ta awán ti nagayoán kenkuána	Lewis ran away, because nobody took care of him.
inlákok met láeñg gapó ta masápulko ti pirák	I sold it though, because I need money.

3. *Agsípud ta.*

agsípud ta iñggána itá awán ti nabirókak	because until now I found nothing.
agsípud ta nalpásko ñga inyáwat	because I had given it already.
agsípud ta dída ammó ti yánnan	because they don't know any more where he is.

agsípud ta dagití táo addáda ití goló	because the men are revolting.
agsípud ta rabií madída ñga umáy	because it is evening they refuse to come.
nagtálawda agsípud ta addá nañgibagá kadakuáda a naúyoñgka	they escaped because somebody told them that you were very strict.

NOTE 18.—Sometimes the conjunction *ket* may translate the English "because", and so on. Examples:

umáyka ket ayabannaka ni áma	come as father calls you.
tulóñgannak ket nadagsén daytóy	help me for this is heavy.
umáykat toy ket matnág	come here as it is falling.

B. 'On account of, for", and so on, is expressed in Iloko by the following conjunctions followed by the oblique:

1. *Gapó.* Examples:

gapó ití dakkél únay a síribmo dawátek a sursuroánnak	because you are very wise, I ask you to teach me.
díka inarámid gapó ití ayatmo kaniák	you did not do it out of love for me.
gapó ití panagsaoda	on account of their talk.
timmaráyda gapó iti butéñgda	they ran away through fear.
napán idiáy Maníla gapó ití sakít ti matána	he went to Manila because he has sore eyes.
inayabánda idá gapó itóy nakalkaldáañg a gásat	they called them on account of this sad fate.
umáy gapó kenká	he comes for you.

2. *Agsípud.* Examples:

saán ñga immáy agsípud ití kaawán ti pirakna	he did not come because he had no money.
agsípud ití saánda a kabaelán ti mapán	because they are not able to go.
agsípud ití kinaubiñgna	on account of his being only a child.
agsípud ití kinabaknáñgmo rebbéñgmo komá ti tumúloñg kadagití napañgláw	because you are rich, you should help the poor.

3. *Maipuón.* Examples:

maipuón ití butéñgna	through fear.
ti bannógna maipuón kenká	her hard work on your account.
maipuón ití sapatá nagbutéñg ket inarámidna met láñg	on account of the oath he was afraid and did it though.
mabaín maipuón kadagití addá a kaduána	he is ashamed on account of the companions he has.

immáyak maipuón ken Ana	I came for Ana.
awátennanto ti sañgagasút a maipuón ití maysá	he will receive a hundredfold (hundred for one).

C. "Therefore, wherefore", and so on, is expressed in Iloko by:

1. *Gapó ta* followed by one of the forms of the indefinite adjective in *kas*: *kastoy, kasta,* and so on. Examples:

gapó ta kastá napán láeñg	therefore he went though.
gapó ta kastóy ñgarúd aramídekto	as it is so I shall do it.
gapó ta kasdiáy mayátak	therefore I am willing.
gapó ta kastá pinatáyna	wherefore he killed him.

2. *Isú ti gapóna,* ordinarily followed by the ligature *a* or *ñga.* Examples:

isú ti gapóna ñga immáykami	therefore we came.
isút gapóna dawátenmi komá kadakayó a díkay komá iláko	therefore we should like to ask you not to sell it.
dákes daytá isút gapóna baybay-ám	that is bad, therefore leave it.
immáy idí kalmán isút gapóna mapankami no bigát	he came yesterday, therefore we go to-morrow.
masakít ti ñgípenna, isút gapóna ñga agikkís	he has the toothache, therefore he shrieks.

3. *Ananså* and *ananså ñgarúd,* ordinarily followed by *ta.* Examples:

ananså ta no ta ñgípenmo agsakít agpaágaska	wherefore, if your teeth ache, you go to the dentist.
ananså ta ínkan	wherefore go now
ananså ta dawátek a tulóñgannak	therefore I ask you to help me.
ananså ta no agparintúmeñgka kúkuamto ámin idá	therefore if you kneel down, all of them will be yours.
isú ti apóm ananså ta addá kalintegánna kenká	he is your master, therefore he has a claim upon you.
ananså ñgarúd a konák kenká	therefore I tell you.
ananså ñgarúd díak bumdéñg a mapán	therefore I am not afraid to go.

4. *Isú ti.* Examples:

isú ti kumákaasikam kenká	therefore we implore you.
isú ti umáyak kenká ta addá ibagák	I came to you because I have something to tell.
addá básolna kaniák, isú ti sinaplítko	he wronged me, therefore I whipped him.

5. *Kárig pay ta* and *kárig kad ta* (rarely used). Examples:

kárig pay ta díka sumuknál kaniák a masakít	therefore you do not visit me who am ill.
kárig kad ta adú ti makítak a táo	therefore I see many men.

II. A very common expression is a word with the form of the future in *to* followed by the adverb *met,* and generally introduced by the conjunction *no.* This expression is hard to translate into English: it implies a kind of excuse for something being done or omitted. Examples:

no kumagátto met	but he bites (how could I approach him?)
no kasdiáyto met	but he is such a one (how could I ?)
no aguñgétto met	he gets angry (how can we ?)
no addánto met nakataktákak	I was delayed (that is why I am late).
no adúnto met ti mapán	so many people go (why should I?)
no awánto met ti immáy	well, nobody came (now can we?)
agkuddótkanto met	but you nip.

III. The following conjunctions might be translated "whereas, while", and so on:

1. *Ata, yáta, antá* and *yantá.* Examples:

áta saánko ñga ammó ti timmúlad kenká iti siñgpetmo, idawdawátannak iti pakawan	whereas I could not imitate your virtue, ask forgiveness for me.
yáta nasapúlam kuámon	whereas you found it, it is yours now.
antá nabóoñgmo agsásaoka pay láeñg	you broke it and still you talk.
antá naarámid bay-ámon	it is done now, leave it.
antá kastá met láeñg a madí intayon	whereas it so happens that he refuses, let us go.
yantá ayaténnak ikkánnak ti dawátek	whereas you love me, give me what I ask.
yantá kúkuam ánim ayoánam ñgarúd	whereas everything is yours, take care of it.

2. *Tañgay, atañgay, antañgay* and *yantañgay,* Examples:

táñgay immáykayo tuñgpalek ti inkarík	whereas you came, I shall comply with my promise.
antañgay naúram ámin rebbéñgtay ti umális	whereas everything is burnt, we shall have to move.
antañgay awan ti pirakmo diká ngarud gatangen	whereas you have no money, don't buy it of course.
yantáñgay isút naglikudányo	whereas you turned your back on it.

ket yantáñgay kastán a dítay maipamuspúsan	and whereas it is now so that we cannot remedy it.
yantáñgay ket díka ammó a paidáman	but whereas you cannot refuse him anything.
awán duaduá a madí yantáñgay saán ñga immáy	there is no doubt about his refusal, as he did not come.

3. *Idínto* (past) and *itá* (present) followed by the ligature *ta, a* or *ñga.* Examples:

idínto ta natáy ni Júan	whereas John died.
ket idínto ta simmálug ni áma	and whereas your father went down.
idínto ta malémen	whereas it was afternoon already.
idínto ñga addá ti lakáy	whereas the old man was there.
ket idínto a dagití kaaróbami napánda nagáni	whereas our neighbors went to harvest rice.
idínto ñga ammóna ti panúnotna kinonána	whereas he knew their thoughts, he said.
itá ta awándan aniá ti aramídek	now that they are gone what shall I do?
itá ta lakáyen madí ñga agsaríta	now that he is old he refuses to tell stories.
itá ta simmañgpet ínkan	now that he arrived you can go.

IV. The following conjunctions represent the notion of the English "while, besides", and so on: *abús ta* and *abús man pay* (*ta*). Examples:

abús ta isú ti makabásol isú pay ti aguñgét	he is the one who makes the mistake and, besides, he is the one who gets angry.
abús ta tinakáwandak índak pay bináut	they robbed me, they also whipped me.
isakítko daytá, abús ta isú maysá kadagití gayyémko	I defend him, as he is also one of my friends.
madíkami a mañgtarakén kadakuáda abús ta bassít ti págaymi	we don't want to feed them, and we have little rice also.
díak kayát ti mapán abús ta awán ti pirákko	I have no money and, besides, I don't want to go.
ínka mettén abús ta malémen	go now and by this time it is afternoon also.
awán ti mayát abús ta túdo la a túdo	it does not do anything but rain and besides, nobody is willing.
díka mapán ta abús ta awán ti palúbosmo nabasá pay ti dálan	don't go, you have no permission and, besides, the road is wet.
abús man pay paturdénna ti táo	and, besides, he makes men bold.

NOTE 19.—After *abús kúa* the sentence seems to be suspended Examples:

abuskuá dakes ti dalan	and then also . . ., the road is bad.

VI. THE CONJUNCTION "ALTHOUGH"

I. A. The most used Iloko conjunctions representing the English "although, even though", and so on, are:

1. *Uray, úray no, úray la no, úray pay no, úray man* and *úray man no.* Examples:

úray awán ti baláymi	although we have no house.
úray nagbalínda a dákes	although they became bad.
úray natáy dítay ilunód	let us not curse him even though he is dead.
úray simmañgpet	although he came.
úray no guráendak	even though they hate me.
úray no madikayo	even though you refuse.
úray no agtálaw	even though he run away.
úray la no konám a dakes aramídekto met láeñg	I shall do it notwithstanding you say it is bad.
úray pay no agsáñgit rebbéñgna ti umáy	even though he weep he must come.
úray pay no baútennak	even though they whip me.
úray man umáyka awánto ti itédko	even though you come I won't give you anything.
úray man no mayát ti lakáy	even though the old man be willing.

2. *Nópay, nópay no, no man pay* and *no man pay no.* Examples:

nópay baknáñgka	although you are rich.
nopay natañgsit bassit no daddúma	although he is a little proud sometimes.
nópay adú ti pirákmo	although you have much money.
nópay awán ditóy ti gayyémko	although my friend is absent.
nópay saán a nalukmég	although he is not fat.
nópay no ikkánnak ibagákto met láeñg a naímut	even though he gives me, I shall say nevertheless that he is a miser.
no man pay saán únay ñga adú ti táo	although there were not very many people.
no man pay napánda idiáy nagsakítda met láeñg	although they went there, they got ill anyhow.
no man pay no adúda	even though they be many.

B. "Nevertheless", and so on, is expressed in Iloko by *nópay* or *nópay no* followed by one of the forms of the indefinite adjective in *kas: kastá, kastóy,* and so on. Examples:

nópay kastá nasiñgpét met láeñg ti konák	nevertheless I think he is virtuous.
nopay kastá daytá a pagkuráñgan mapunnoánto met láláeñg	nevertheless that want will be supplied.

nópay kasdiáy ínnakto tulóñgan	although it is so, I shall go to help him.
nopay no kastá adúnto met láeñg	however, there will be many anyhow.
nópay no kastá awán ti bibiañg mo	however, it is not your business.
nópay no kastá saán ñga agnanáyon a masurot daytóy	nevertheless this is not always followed.

II. With the infix *imm* and the suffix *an*, and occasional reduplication of the first open syllable of the stem together with the next consonant if there is any, the Iloko forms a kind of conjunctional phrase which includes the concept of the English "although", provided of course that another clause, introduced by *ket*, follow or be understood. Examples:

limmalakiánka ket natakrótka	although you are a man you are timid.
simmayaátan pay ti saó ket dída ikankanó	although we speak nicely they do not heed it.
bimmabaiánka ket uminúmka iti árak	although you are a woman you drink wine.
immaduán ubbíñg ket awán pay mañgmañgñgég	although there are many children nothing is heard.
bimmassitán a tattáo ket napúdot	although there are few people around, still it is hot.
pimmigpigsáankayo ket saányo a maidurón	although you are strong you cannot push it.
limmaklakayánda ket inuubiñgán ti arámidda	they are old men, however they act like children.
kimmapkapúyan ket kayátna a bagkáten	he is weak and still he wants to lift it.

VII. THE CONJUNCTION "LEST"

This conjunction is expressed in Iloko by:

1. *Intóno* (ordinary form), *tóno, attóno* and *antóno.* Examples:

madíak intono aguñgét	I won't lest he get angry.
tóno maikkátak	lest I be discharged.
attóno pagtalawennak	lest he drive me out.
bay-ám antóno madí	leave it, what if he refuses?
ínka intóno saplítennaka	go lest he whip you.
umáykami ditóy intóno pumatáyda ketdín idiáy	we come here lest they kill us there.
darasém intóno kamátennaka	be quick lest he catch you.
aluádanyo intono makitada	be careful lest they see it.
ibusém intono madlawda ti kaaddána	finish it lest they notice its presence.

2. *Wennó* and *annó* (rarely used). Examples:

ta wennó isúdanto no kúa ti kadadakkelán	lest they be the greatest afterwards.
ibusém ti tinúpay annó pusáen	finish the bread lest the cat eat it.

3. *Intó* (*la*) *ket* (*dí*) *no, adtó* (or: *attó*) (*la*) *ket* (*dí*) *no* and *antó* (*la*) *ket*(*dí*) *no.* Examples:

rikpánná intó ket no sumrék	he closes it lest she enter.
agtaráyka intó ketdí no isú ti umoná	run lest he be the first.
intó la ket no masulisog	lest he be tempted.
aláemon intó la ketdí no madí no bigát	take it now lest he refuses tomorrow.
itúgotmo ti páyoñg adtó ket no tumúdo	take an umbrella with you, it might rain.
sibugám attó ketdí no matáy	water it lest it die.
igálutmo attó la ket no tumaráy	tie him lest he run away.
ipañgínam attó la ketdí no gatáñgenna	augment its price lest he buy it.
ínka itá antó ket no marikpán no malém	go now, it might be closed this afternoon.
siká komá antó ketdí no sabáli ti makaála	you should, so that nobody else can take it.
ínka ibagá antó lá ket no sumañgpetda	go and tell him lest they arrive.
ínka antó la ketdí no umáy ditóy	go lest he come here.

NOTE 20.—The conjunction *ánnó* (*la*) *ket* (*dí*) *no, no lá* (*eñg*) *no* and *ket saán* (*ñg*) *em* have become more or less antiquated. Examples:

Examples:

darasém ta annó la ket no maon-onaánnata ti lakáy	be quick lest the old man get there before we do.
intayon ket saán ñgem maléman	let us go lest it be afternoon.

4. *Di la ket, di la ket anó, di la* (*ket*) *mamin-anó* and *di la ket agkapin-anó,* generally followed by *ta.* Examples:

di la ket ta mapárutyo ti págay	lest you pull up the rice.
di la ket ta pumañgláwka	lest you become poorer.
di la ket ta mabaybay-ántayo	lest we be left out.
di la ket anó ta masarókanda sáda itaráy	lest they find it and run away with it.
di la mamin-anó ñga awánen	lest there be nothing left.
di la mamin-anó ñga addá mañgála ití saánmi a kayát	lest somebody take what we don't like.

di la ket mamin-anó ta pukáwenna idá	lest he destroy them.
di la ket agkapin-anó ta sumrékda ití unég ti baláy	lest they enter the house.

5. *Aniá ket, aniá la ket, aniá ketdí* and *aniá la ketdí,* generally followed by *ta.* Cfr. XII. Other Conjunctions. 1. Examples:

ikkatém aniá ket ta payátenda idá	take them away, lest they trample on them.
aniá la ket ta masarákandaka a silalábus	what if they find you naked?
aniá ketdí ta baútennakayo	lest he whip you.
aniá la ketdí ta ti kabúsormo yáwatnaka ití okóm	lest your enemy deliver you to the judge.
aniá la ketdi ta intón dumtén͠g ití makláat masarákannakayo a matmatúrog	lest, when he comes unexpectedly, he find you asleep.
aniá la ketdi ta parútenyo ti págay	lest you pull up the rice.
aniá la ketdí ta addá maaramid a riríbuk	lest a disturbance take place.
aniá la ketdí ta umáy	lest he come.

VIII. THE CONJUNCTION "PROVIDED"

I. The conjunction "provided" is rendered into Iloko by:

1. *No la ket(dí)* and *no la ket(dí) no.* Examples:

no la ketdí napudnó	provided that it be true.
no la ketdí saán a maisupiát ití pagimbagántayo	provided that it be not against our own good.
no la ketdí awán ti suman͠gpét itá agay-áyamtayo	if nobody arrives now, we shall play.
no dagití paspásigko díka la ket idá kaúma	provided that you do not get tired of my familiarity.
no la ket no díak makaarámid ití básol	provided that I commit no sin.
no la ket no díak ran͠gásan ti gayyémko	provided that I do not injure my friend.
no la ketdí no addá pirákko	provided that I have money.

2. *No . . . la* and *no . . . la ket(dí).* Examples:

no bumaknán͠g la dagitá a kas ití konám	provided that those ones become rich as you say.
no sipapakuran͠g la ketdí	provided that he be humble.
no mayát la ketdí ti bakétmo umáyka	provided that your wife agree, come.
no awán la ketdí ti tímel matúrogkamí idiáy	provided there are no fleas, we shall sleep there.
mayátak no awán la ketdí ti sakítko	I am willing provided I am not ill.

II. The Iloko conjunctions *báreñg* (*pay*) and *báreñg* (*pay*) *no* express a wish, but at the same time include a certain doubt about the expected result, like the English: let us hope that. Examples:

báreñg dikanto agsagsagába	let us hope you won't suffer.
báreñg pakawanénna	if perhaps he forgive it.
báreñg ipalúbosna	if perhaps he allow it.
báreñg pay maikkát ti sakitna	let us hope that his illness will leave him.
báreñg no mayát	let us hope he'll be willing.
inka báreñg no masapúlam ti napúkawmo	go, you may perhaps find what you lost.
umasidégak báreñg pay no addá met itédna kaniák	I approach hoping he will give me some also.

IX. THE CONJUNCTION "CONCERNING"

I. The typical conjunctions to express this concept in Iloko are:

1. (*Iti*) *maipapán* and *no maipapán*, followed by the oblique. Examples:

iti maipapán kadakayó	concerning you.
adú ti inbagána maipapán iti ipapatáy daydi ubiñg	he said much about the death of that child.
awán ti saómi maipapán iti daytá	we said nothing about that.
maipapán iti panagdúyosda iti makipalpalamá ñga aggapót sabáli ñga il-íli	concerning their protecting the beggars who come from other towns.
no maipapán iti anákmo awán ti nadámagko	I heard nothing concerning your son.
no maipapán iti baláy a ginátañgko awán met kanó agámañgna	concerning the house I bought, I heard there was no granary with it.

2. *Agpapán pay.* Cfr. The Adverb. VIII. Other Adverbs. I. 3; The Preposition. III. 1[7]; Conjunctions of Time. 8. Examples:

agpapán pay mapúkawmo narigatto kanó a mabirókan	as regards what you lost, they say that it will be difficult to find it.

NOTE 21.—(*Iti*) *maipañggép* and *no maipañggép* mean either "concerning" or "in behalf of". Examples:

adú ti inpalawágna maipañggép iti pannakaúram ti baláyna	he related much concerning the burning of his house.
no maipañggép iti nadámagko kastóy	as regards what I heard, it is this.

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[7] Philip. Jour. Sci. 75 (1941) 197–225.

ibagák daytá maipañggép ken ína	**I say that in behalf of my mother.**
maipañggép ití simbáan	**for the church.**

II. A common way of expressing the concept "concerning" is the simple conjunction *no*. Examples:

no kananákemko a maysá	**as to my opinion.**
no kaniák a maysá	**concerning myself.**
no siák a maysá	**concerning myself.**
no ni ína ammók a madí	**as to my mother, I know that she refuses.**
no isúda mabalín a mapánda	**as to them, maybe they go.**

III. The concept "concerning" is sometimes expressed by the oblique in a kind of opposition preceding the sentence. Examples:

ití maikapat awán ti ammók	**concerning the fourth, I know nothing.**
ití laláki napigpigsá ñgem ti babái	**concerning the man, he is stronger than the woman.**
kaniák a maysá nasayáat ámin	**to me everything is good.**
ití ásom nalukmég	**concerning your dog, he is fat.**
ití baláyko nalpásen	**as regards my house, it is finished.**
ití saóyo naalás	**concerning your speech, it is unbecoming.**

X. CONJUNCTIONS OF TIME

1. To introduce a clause in the past: *idí* followed or not by the ligature *ta, a* or *ñga*. Cfr. The Verb. Moods and Tenses. I. 2[8].

idí ta nabisín nagsañgsañgit	**when he was hungry he wept.**
idí ta nagáwid limmábas idiáy baláymi	**when he went home he passed our house.**
idí a kastá dagití sañgapúlo napánda	**then the ten went.**
idí ñga inayabánnak inpalawágna ámin	**when he called me he explained everything.**
idí dimmatéñg napalálo ti bannógna	**when he arrived he was very much tired.**
idí awánkami nagtálaw	**when we were gone he escaped.**

2. To introduce a clause in the future: ***intóno, tóno, no, attóno*** and ***antóno***. Cfr. The Verb. Moods and Tenses. III. 1[9].

3. To connect two clauses, the first of which precedes the second one in time: *sa* and *sánto*. Cfr. The Verb. Moods and Tenses. IV[10].

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[8] Philip. Jour. Sci. 75 (1941) 197–225.

[9] Philip. Jour. Sci. 75 (1941) 198.

[10] Philip. Jour. Sci. 75 (1941) 199.

4. "After" is expressed by (*iti*) ***kalpasán*** and (*iti*) ***kalabsán***, followed by the genitive. Examples:

kalpasán ti panagsúratmo ipaw-ítmo ti súratko	after you have written send my letter.
kalpasán ti pannáñgán	after meals.
iti kalpasán ti panagsáñgit-da nagkatáwada	after they had wept they laughed.
iti kalpasánda ámin	after all of them.
iti kalpasánna agúñgarakto	afterwards I shall arise from the dead.
kalpasán ti talló ñga aldáw umáyakto	after three days I shall come.

5. "Before" is expressed by:

a. (*Iti*) *kasañgoánan* and (*iti*) *kasakbáyan*, followed by the genitive. Examples:

kasañgoánan ti ipapatayna nagluálo	he prayed before he died.
iti kasañgoánan ti yaáyko ditóy maymaysá ti baláy	before I came here there was only one house.
kasakbáyan ti panagdáwatyo	before you ask.
rebbéñgmo ti agságad iti kasakbáyan ti panagádalmo	you must sweep it before you study.
iti kasakbáyanna nasiñgpét	he was virtuous before.

b. *Sakbáy*, followed by the genitive. Examples:

iti rabií a sakbáy ti ipapánmo	the evening before you went.
iti aldáw a sakbáy ti isasañgpétmo	the day before you arrived.
sakbáy toy awán ti mayát	before this nobody was willing.

c. Some negative expressions in the past tense. Examples:

itá ta di pay natáy	before he dies.
itá ta awán pay ti immáy	before anybody comes.
natáy idí di pay nalpás ti baláyna	he died before this house was finished.
saán ket a di nagkarí	not before he promises.

6. "During" is generally expressed (*iti*) *bayat ti*. Examples:

báyat ti kaaddám ditóy	during your stay here.
báyat ti duá ñga aldáw awán ti kinnánna	he did not eat anything for two days.
nagsáñgit iti báyat ti panag-saritak	he wept while I talked.
iti báyat sañgagasút a tawén	for one hundred years.

7. "Till" and "since" are expressed by: *iñggá* (*t*), *iñggána* (*t*), *agiñggá* (*t*) *and agiñggána* (*t*), followed or not by *ti*, *iti*, *di*, *ti di*, *iti di*, *ti saán*, *iti saán* or *idí*. If the subordinate clause is

in the present, the conjunction means "till"; if it is in the past, the context must show whether it means "till" or "since". Cfr. The Preposition. III. 3[11]. Examples:

iñggát dína maasáas	till he has learnt it thoroughly.
iñggánat matáyak	till I die.
iñggánat aggíbus ti lúboñg	till the end of the world.
iñggánat ti dína masarákan ti napúkawna	till he finds what he lost.
dídanto maramanán ni patáy iñggána ití dídak makíta	they will not taste death till they see me.
iñggána ití dumtéñg	until he arrives.
agsápulkayo iñggána ití diak dumtéñg	look for it till I arrive.
awán ti pañgibagaánda iñggána ití di malpás	they tell nobody until it is finished.
iñggána ití panagbiágna	during his life.
iñggána ití manó ñga aldáw ti palabsénna	until many days are passed.
iñggána ití lumábas ti láñgit ken dagá	till heaven and earth pass.
iñggánat ití mabayádan ámin	till everything is paid.
iñggána ití panagápit	until the time of the harvest.
iñggána ití ikábilko dagití kabúsormo a pagbatayán dagití saksákam	till I put your enemies your footstool.
agiñggá ti makapañgának ken makainúmak	till I eat and drink.
agiñggát mabayádan ámin	till you have paid everything.
agiñggá di agmagá	till it dries.
agiñggá ití maikkát	till it is gone.
nagyán toy iñggánat ti saán a nalúto ti tinápay	he stayed here until the bread was baked.
agsiñgpétka iñggánat ití díka matáy	be virtuous until you die.
nagbásolda agiñggá ití immáy ti layús	they sinned till the deluge came.
saánda a namáti agiñggá ti inayabánda dagití naganák kenkuána	they did not believe till they called his parents.
nalukmég agiñggát inpasñgáyna ti anákna	she was fat until she brought forth her child.
isú ti nagtaeñgak agiñggá idí ipapatáy ti lakáy	I dwelt there until the old man died.
bimmassít la a bimmassít ti pirákna iñggánat nagsardéñg ti panaginúmna	his money diminished all the time till he stopped drinking.
iñggánat nagsardéñg ti panaginúmna umadú la ñga umadú ti pirákna	since he stopped drinking his money augments all the time.

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[11] Philip. Jour. Sci. 75 (1941) 197–225.

iñgganat nagsardéñg ti panaginúmna immadú la ñga immadú ti pirákna	since he stopped drinking his money augments all the time.
iñggána idí ipapatáyna awán ti gásatmin	since he died we have no more luck.
iñggána idí inbagák nasiñgpét mettén	since I told him he is virtuous though.

NOTE 22.—As may be seen by the above examples, the negation generally does not affect the meaning of the sentence. The reason is this: *iñggana* means literally "its end"; now if you say *iñgganat natay*, you mean "his death was the end, till he died". In the first sentence, you analyze the original meaning of the conjunction and place the stress on "the end"; in the second sentence, you take the conjunction simply as a conjunction and place the stress on "the period of duration". In practice both forms are equivalent.

And so also with *agiñggá*, which means literally, "it ends". *Agiñgggát natáy*, "it ended in his death, till he died"; *agiñggat di natáy*, "as long as he did not die, till he died".

NOTE 23.—These conjunctions sometimes convey the notion of the English "during, as long as," as may be seen by the above examples and by the explanation given in the preceding note.

8. "Till" is also expressed by *agpapán* followed by a term that includes the notion of the present or of the future; "since" is also expressed by *manípud idí* or *sípud idí* followed by a term that includes the notion of the past. Cfr. The Preposition. II. 2. b. and III. 1[12]. Examples:

agbasbása agpapán agsápa	he reads till early in the morning.
agpapánto ti panagsúratmo	till when will you write.
manípud idí simmañgpet awán ti sabáli ñga inarámidna ñgem ti agsáñgit	since he came he has done nothing but weep.
manípud idí immáy	since he came.

9. "Whenever" is expressed by: *patináyon no, ámin no,* and *tumuñggal.* Examples:

patináyon no umay ditoy addá kagaténna ñga ubíng	whenever he comes here he bites a child.
adú ti kótomi patináyon no addákayo	we have many lice whenever you are here.
patináyon no makítak nabarték	every time I see him he is drunk.
ámin no addáka ditóy agkúrañg ti kanénmi	whenever you are here we lack food.
tuñggál malagípkayo	whenever I remember you.
tumuñggál balikséнna dagitóy a saó	every time he pronounces these words.
tumuñggál lualoéntayo daytóy	whenever we recite this prayer.

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[12] Philip. Jour. Sci. 75 (1941) 197–225.

10. "As soon as" is expressed by *apáman*, followed by the ligature *a* or *ñga*. Examples:

apáman a malpás ti pompón íntayo	as soon as the burial is over let us go.
apáman ñga apagsaóna daytóy	he had scarely said this.
apáman a nakakaán nagsakít	he had scarely finished eating when he got ill.

XI. CONJUNCTIONS OF COMPARISON

I "As, like", are expressed by:

1. (*a*) *kas*, (*a*) *kas lá*(*eñg*), (*a*) *kas man* and (*a*) *kas man lá*(*eñg*), followed or not by the oblique. Examples:

kas pay isú ti yan ti kuspágda	that seems to be the reason of their self-conceit.
panagaw-áwatko kásna kayát a gatáñgen ti balayko	as I understand it, he wants to buy my house.
kásna naawán ti ladíñgitna	he seemed to have cast off his sorrow.
kas addá tultúleñgna	he seems to be a little deaf.
kásna palukneñgén	he seems to soften it.
rugiákto ti kas mañgrikná ken ulitégko	I shall begin to sound my uncle (to act like sounding).
maarámid kenká kas pagayatám	what you like is done to you.
kásdanto kadakamí	they will be like us.
kas ití ubiñg	like the child.
aláem ti kas itédko kenkuána	take the same as what I give to him.
kas ipalawág ti lakáy	as the old man explains.
kásna tandá	as a sign of it.
a kas aniníwan	like a shadow.
a kas maysá a taném	like a grave.
a kas iti panañginanámak kenkát agnanáyon	as I always hope in you.
a kas ití konám	as you say.
a kas kaniák met ditóy	like me here also.
a kas ket sakitén ti nákemda	they seem to feel sorry about it.
ti umoná a kas ket ití maúdi	the first is like the last.
a kas idí kagagapóna	as in the beginning.
naidarúm a kas agdadáel kadagití kúkuana	he was accused of destroying her property.
a kas nasiñgpét	like virtuous (he seems to be virtuous).
a kas ken amána	like his father.
a kas itá	like now.
kásnak la anák	I am like a child to him.
kas met la idí	just like before.
kas láak tumayáb	I seem to fly.
kas la kastá	it looks like it.
kas lat itáy	like a while ago.

no ti nam-áymo ñg̃a agbiág ta kas la komá iti pusaksák ken ayamóom sabsábuñg̃ dagiti ar-arapáapko	may you live in ease and abundance, a life comparable to the purity and fragrance of the flowers of my fancy.
a kakás la táo	as men.
táo a kas la kaykáyo	men like trees.
kas man díak umáy ditóy	as if I don't come here.
kas man la díka makagunód	you seem not to be able to get it.

2. *(k)árig*, *(k)árig lá(eñg̃)*, *(k)árig man* and *(k)árig man lá(eñg̃)*, followed or not by the ligature *ta*, *a* or *ñg̃a*. Examples:

árig a táo a magmagná	like a man who walks.
dagitóy árigda ñg̃a agasáwa	these ones look like a married couple.
kárig la matmatúrog	he seems to be asleep.
árig la a bató	like stone.
árigkayo la ñg̃a agsadút	you look lazy.
árig la ta madí	he seems to refuse.
árig man a díak kayát	I think I won't.
árig man ñg̃a addá ammóna	as if he knew something.
árig man la dína kayát	as if he didn't like it.

3. *(Ka)páda* and *(ka)padpáda*, followed by the genitive. Examples:

kapádak daydiáy	that one is like me.
kapádada la únay dagiti baláy idiáy ílimi	the houses in our town are just like them.
kapadpáda ti ásomi	he is like our dog.

II. 1. "As . . . as" is expressed by:

a. *a kas* and *a kas lá(eñg̃)*, followed by the oblique. Examples:

naimbág a kas kaniák	as good as I.
nasiñg̃pét a kas iti anákko	as virtuous as my child.
nasadút a kas ken Ana.	as lazy as Ann.
natakrót a kas la ugsá	as timid as a deer.
uminúmka a kas la sarañg̃ósoñg̃	you drink as much as a funnel.

b. the terms *(ag)páda*, *(ag)papáda*, *(ag)padpáda* and *(ag)padapáda* (past: *nag* . . .). Examples:

pádada a nasiñg̃pét	he is as virtuous as they.
ti pádak a táo	my neighbor (literally: a man like me).
agpapádada a naimbág	the one is as good as the other (they are equally good).
padpádana a masírib	he is as wise as he.
agpadpádakayo a nasadút	you are both equally lazy.
padapádada ñg̃a ur-úray	he is as worthless as they.
nagpadapádada a dákes	these ones were as bad as the others.

2. "Not so . . . as" is expressed by:

a. a negative followed by *a kas* or *a kas lá* (*en͠g*). Examples:

saán a kas ití baláyko	it is not so (good) as my house.
saán a kas ken Ana	she is not so (active) as Ann.

b. a comparative adjective indicating the reverse quality. Examples:

dakdákes n͠gem ti baláyko	it is worse than my house (not so good).
nasadsadút n͠gem ni Ana	she is lazier than Ann (not so active).

III. 1. "As . . . so" is expressed by (*a*) *kas . . . kastá met* and *no kasanó . . . kastá met.* Examples:

kas ití naarámid kadagidí aldáw ni David kastánto met ti maarámid no kuá	what happened in the days of David, the same will happen then.
kas sadí lan͠git kastá met ditóy dagá	as in heaven so also here on earth.
kas ití kinaadú ti kinabaknán͠gmo kastá met ti kadakkél ti útan͠gmo a panagpakúran͠g	the richer you are the more you are obliged to be humble.
kas ití kaláwa ti tálonmo kastánto met ti kaadú ti pagayna	according to the width of your rice field, such will be the quantity of its rice.
kas kenká kastá met kaniák	as with you so also with me.
kas ití inarámidmo kastánto met ti aramíden dagití annákmo	as you did so also will your children do.
no kasanó ti gagétna kastánto met ti maálana a gongoná	he will get a reward in accordance with his diligence.
no kasanó ti agturáy kastá met ti ituturayánda	as with the governors so also the governed.
no kasanó ti kaatiddágna kastá komá met ti kaakábana	it should be as broad as it is long.

2. "So . . . that" is expressed by *kastá únay . . . ta* and *kastá únay . . . a* or *n͠ga.* Examples:

kastá únay ti kaadú ti kinnánna ta nagsakít ití báyat ti duá n͠ga aldáw	he ate so much that he was ill for two days.
kastá únay ti sadútna ta dína kayát ti man͠gasáwa	he is so lazy that he doesn't want to marry.
kastá únay ti gagétda ta nakagátan͠gdan ití baláyda	they are so active that they have been able to buy a house.

kastá únay ti kabassít ti bagás ditóy íli a rebbéñg datáo ti mañgán iti sábog	there is so little rice in this town that one is obliged to eat millet.
kastá únay ti saóna a nagbutéñg dagití isú ámin a kaarróbana	he talked so loudly that all his neighbors were afraid.

IV. "Especially" is expressed by one of the following terms, followed or not by *no* or *ta:* (*nañg*) *nañgróna* (*únay*), *sañgkañgróna* (*únay*), *maysá únay*, *lálo* (*únay*), *aglálo* (*únay*). Examples:

nañgróna ití bigát	especially in the morning.
díka mapán nañgróna únay ta agsakít ti ólom	don't go especially now that you have the headache.
nañgroná únay no awán ti ápit	especially when there is no harvest.
nañgnañgróna únay ti ólona	especially his head.
dákesto maysá únay no saán ñga umáy ti ur-uráyenna	it will be bad especially if the one he is waiting for does not come.
lálo no kitkitáenna	especially when he looks at it.
tarimaánem ti panagsaóm aglálo kadagití agturáy	mind your speech especially when (talking) to persons in authority.
saán a makapagná aklálo ta dákes ti dálan	he cannot walk especially on account of the bad road.
aglálo únay no madí ti bakétna	especially if his wife refuses.

NOTE 24.—*Sáman* (*no*) is a conjunction of little use; it means "as if", and ordinarily occurs in the form of *sáman* (*no*) *di*, "as if not". Examples:

sáman no dakkél ti kinabaknáñgna	as if he were rich.
nagagétda konáda sáman no makapañgabélda ta mabayágda a masakíten	they are diligent, they say, as if they could weave being ill for so long a time.
adú pay ti págay konáda sáman di inibús ti dódon	they say that there is much rice as if the locusts had not ravaged (the fields).
umanáy sáman no di isú ti kakaroán a dúsa	it is enough, as if it were not the heaviest punishment.
abábaw ti karayán konák sáman no di adálem	I thought the river was shallow but it seems to be deep.
adú ti ayabánda sáman no díkam bassít	they call many as if we were not few.

XII. OTHER CONJUNCTIONS

1. *Tapnó*, "so that, in order that", and so on; "lest", in negative clauses. Examples:

pinaayabánka tapnó kitáem daytóy	I had called so that you look at this.

deñggém ti saóda tapnó dídaka sapliten	hear their words lest they whip you.
patiém tapnó maikaríka ñga ayaténnaka	believe it so that you deserve his love.
ginátañgko ti baláyna tapnó di mapúkaw ti pirákko	I bought his house so that my money does not get lost.
simmañgpét ditóy íli tapnó makabírok ití gatgatáñgenna	he arrived in this town to look for things to buy.
agánuska tapnó addá gongonám	be patient so that you have a reward.

2. *Maysá pay* and *sánto maysá,* "besides". Cfr. also The Conjunction "because". Examples:

awán kadakamí ti mañgán ití daytá maysá pay nañgína únay	none of us eats that and besides it is very expensive.
madí ti nákemko maysá pay addá sakít ití dítoyko	I am against it and besides I feel pain here.
no mapán met ti lakáymo sánto maysá nasayáat ti dálan	and your husband also goes, besides the road is good.
adú ti págayna sánto maysá nakiasáwa ití baknáñg	she has much rice and besides she married a rich man.

3. *Malaksid no,* "except if". Examples:

díka gatáñgen malaksíd no saánmo ñga ammó no sadín ti pañgipanám ití pirákmo	don't buy it except if you don't know where to carry your money.
awán ti mayát malaksíd no kumúyogka	nobody is willing except if you go with them.
kayátko ti mapán idiáy Bontók malaksíd no awán ti mañgisúro ití dálan	I want to go to Bontok except if there is nobody to show me the way.

4. *No kasta.* "thus". Examples:

no kastá awán	thus he is not there?
agáñges no kastá saán pay a natáy	he breathes, thus he is not yet dead.
addá no kastá ínkan	he is here, thus go now.
no kastá awánen	if so we are done for.

5. *Dáel, dáel láeñg, dáel kad pay* and *dáel sa kad pay,* followed by *no* or *ta,* "it is well, scarcely", and so on (rarely used). Examples:

dáel ta makíta daydiáy a baláy	that house is scarcely visible.
dáel láeñg ta mañgñgég ti tímekna	his voice is scarcely audible.
dáel kad pay ta addá igátañgko	it is well that I have something to buy with.

dáel sa kad pay no addá gumátang̃ ta madadáelen	it were well would somebody buy it, as it is getting spoiled.
dáel sa kad pay ta nang̃téd	he scarcely gave.

6. *Asi* (*pay*) and *ay-áy* (*pay*), "woe to". Examples:

ási pay ni Juán	woe to John.
ásikanto pay	woe will be you.
ay-áyka ubíng̃	woe to you, child.
ay-ayak pay iti kastóy a gásatko	woe to me for having such luck (bad).

NOTE 25.—*Alánto* (*kad*) *no* and *ásinto* (*no*) have become antiquated. Examples:

alánto kad no madánondaka ditóy	woe to you if they find you here.
ásinto no maibbatánna	woe to him if he drops it.

APPENDIX: THE INTERJECTION

1. The following are the most used interjections, some of them being sometimes used as conjunctions:

ay	"ah."
ay píman píman, píman and *kaási*	"alas; poor (boy, and so on)".

Kailalá (*pay*), *ilala pay* and *alalá pay*, alas it is a pity. Examples:

kailalá ti báng̃a a nabóong̃	it is a pity the pot is broken.
kaililá pay ti ayátda kenka	it is a pity they loved you.
ilalá pay ti rígatda	it is a pity they endured much hardship.
alalá pay ti págay a nadadáel	it is a pity the rice is ruined.

Assí, pes and *puég:* expressing disgust.

Assiáy and *issiáy:* expressing disgust mixed with wonder.

Ni, ií and *na:* expressing wonder.

Allá: wondering and threatening.

Apayá únayen, ayá únayen, ápa únayen, anía únayen, únay mettén and *únayen:* expressing wonder more or less mixed with the notion of opposition. Examples:

ayá únay komán no deng̃génnak	I wish you would listen to me.
ápa únay ti bayágdan	what is the matter that they stay so long?
únaykan	what is the matter with you?

NOTE 26.—The interjections *abagá, abágay* and *apaká* have become antiquated.

Ananáy and *annáy:* expressing pain.

Oy: calling or attracting attention.

Alá and *alég:* driving on. Examples:

agtaráyka alá	run now.
alá wen	all right.

Alá man, alá kadí, alá komá, alán and *alég komá:* asking a favor. Examples:

alá komá kataléknu italiáwmo kadakám dagitá matám a manañgñgaási	turn then, most gracious advocate, thine eyes of mercy towards us.

Baá: to startle people or to make children laugh.

Uray, úrayen, úray láeñgen and *di kad úray,* "even so; never mind".

Sápay (*komá*) *ta kastá,* "amen; be it so".

Tóto, tóo and *kóta:* calling dogs.

Rísay and *urísay:* calling pigs.

Sa: calling or driving away cats. The difference lies in the pronunciation: *sa,* short and strong: driving away; *sa,* long and smooth: calling.

Siú: driving away chickens, pigs, and so on.

II. The following are the usual greetings of the Iloko:

A. With or without a possessive of the second person: Examples:

naimbág ñga aldáw, "good day".
naimbág a malém, "good afternoon".
naimbág a rabíi, "good evening; good night".
naimbág a fiésta, '"happy feast".
naimbág a páskua, "happy feast (Christmas, Easter; sometimes Epiphany, Whitsuntide)".
naimbág a viáje, "I wish you a happy trip" (to persons going on a journey).
naimbág ñga isasañgpét, "welcome" (to persons coming home).

B. With or without a personal pronoun of the second person in the oblique:

Diós ti agñgína (*kenká* or *kadakayó*), "thank you" (literally: may God repay you).
Diós ti bumáles, "thank you" (may God return it).
Diós ti kumúyog, "may God go with you" (to persons going away).
Diós ti agbáti, "may God stay (with you)" (said by persons going away).
Diós ti mañgágas, "may God cure you" (to sick or tired persons).
Diós ti mañgliwliwá, "may God console you" (to bereaved persons).

C. *Yáman pay,* "thank you"; also the usual answer of the inmates of a house to the greeting of a person making a call.

awán aniá man, "you are welcome", answering "thank you".
lumábaskami (*pay*), "we pass", when passing over the grounds of and near somebody else's house.

NOTE 27.—"The late" is expressed by *ni Dios ti aluádna*, followed by the ligature *a* or *n̄ga*, and by *ni . . . a Dios ti aluádna*. Examples:

ni Diós ti aluádna n̄ga asáwak	my late husband; my late wife.
ni Luís a Diós ti aluádna	the late Lewis.

BOOKS

Books reviewed here were received from their respective publishers by The Philippine Journal of Science and are acknowledged in this section.

First-Year Mathematics for Colleges. By Paul R. Rider. New York, The Macmillan Company, 1949. 714 pp. Price ₱10.00

This book is intended principally as a textbook in first year mathematics for colleges. The methods of presentation are those used in Rider's "College Algebra, Plane and Spherical Trigonometry, and Analytic Geometry". The treatment of the topics is very clear and the arrangement of the subject matter, logical. The book has been provided with a complete index which enhances its usefulness. It is a good regular text in universities as well as a suitable reference book in a college library.—E. R.

Alternating Current Machinery. By L. V. Bewley. The Macmillan Company, 1949. 876 pp. Price, $5.25.

This book is unusual in two respects: 1. It presents the theory and characteristics of alternating current machinery with two general equations: (a) the equation of voltage and (b) the equations of armature reaction, and 2. It gives the most recent advances in theory and method of analysis applied to alternating current machinery.

The use of the two general equations presented in the book makes it possible to distinguish one electrical machinery as differing from another by either the presence or absence of specific terms in the general equations. The general equations, therefore, are to the field of electrical engineering as the Bernoulli equation is to hydraulics. It must be said, however, that it is not possible to do away completely with the old methods of solving the old equations. The author eliminated the useless methods and equations, and discussed applicable ones in his book: It is not too much to expect that as the method pioneered by the author becomes more generally understood and wisely applied, a greater unification of ideas and basic concepts will result in the field of electrical machinery.

Other important and interesting features introduced by the author in the book are the following: 1. The concept of a fictitious winding in a transformer to account for the core loss and to represent the consolidated eddy-current circuits; 2. The step-by-step development of the equations, vector diagrams and equivalent circuits of the transformer and polyphase induction motor; and 3. The cross-field principles involved in the single phase induction motor which is made clear by referring to time and space vector diagrams.

One may criticize this text on the omission of discussions on flux distribution in slots, air gaps and around field poles in electrical machineries, and eddy-current loss in conductors which are usually part and parcel of books in this general field. The author, in his book "Two Dimensional Fields In Electrical Engineering", treated these subjects exhaustively. Other topics that are omitted are the mercury arc, rectifier, electronic devices and the eddy-current and hysterisis motors which are used in instrumentation. I agree with the author that these electrical machinery should be treated in separate books on industrial electronics and specialized electrical machines.

Simplifying assumptions are used extensively in the book. In fact, in some instances, the simplifications have become oversimplifications. It must be said, however, that the mathematical manipulation necessary for complete understanding of a subject is omitted in the interest of simplification.

This book can be recommended as a reference for practicing engineers and as a text in electrical engineering course.—F. V. E.

Pre-Medical Physical Chemistry. By F. A. Matsen, Jack Myers and Norman Hackerman. N. Y., The Macmillan Company, 1949. 344 pp., illus. Price, $4.50

As its title implies, the authors intended this book for premedical students only, and as such this is not the usual physical chemistry text. In carrying out this intention, only those "chemistry principles which now have, or expected will have, application to the study of medicine and other biological sciences" are treated comprehensively as in the case of surface phenomena.

The topics covered have been chosen with a purpose. The first chapter reviews elementary mathematics and introduces more advanced mathematical operations. The material is so arranged as to give the instructor enough leeway in the preparation of the course so that topics may be omitted without a serious consequence. At the end of every chapter references to assist the student desiring additional information, and problems to provide review and exercise are given.

Going through its twenty-five chapters, one will find that the book is far from being an easy one and the aim of the authors have been more than adequately fulfilled.—L. G. A.

Physical Chemical Experiments. By Robert Livingston. Revised Edition. New York, The Macmillan Company, 1948. 267 pp. Price, $3.50

An interesting feature of this book is the detailed discussion on measurements, errors and computations with formulas, equations and illustrations, which are substantiated with experiments for easy comprehension and application. This part of the book is very useful and handy as it eliminates the necessity of consulting various references for these processes.

The book contains fifty experiments presented in the same manner as those of other textbooks on laboratory or experimental physical chemistry. The theoretical consideration is as usual, at the beginning of each experiment, followed by the apparatus, materials, procedure and lastly computations. One noticeable feature in the description of the various experiments is the absence of details. Details were apparently omitted, leaving them entirely to the student in order to develop discretion, initiative and resourcefulness. Also, experiments presented in this book are those requiring minimum expense for equipment but sufficient to acquaint the student with the fundamental principles involved in the course of experimental physical chemistry.

The value of this book should be well appreciated by the student whose interests extend to the practical applications of some of the experiments to organic chemistry, chemical engineering, biochemistry and other allied subjects.—N. F. M.

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TWENTY-SIX NOTEWORTHY PHILIPPINE FISHES

By ALBERT W. C. T. HERRE

Of the School of Fisheries, University of Washington

In working on the collections made in Philippine waters during 1947 and 1948, many fishes were discovered that previously were only known from the East Indies, Japan, India, or elsewhere. A number of others were obtained from Philippine seas for the second time, and are rare enough to deserve special mention. Wherever possible the new finds were incorporated in my Check List of Philippine Fishes, but the species mentioned in this article did not come to hand until too late to be inserted in it. Two species given here have been taken once before in the Philippines, but their rarity makes it worth while to record their second occurrence in the Island waters. All the rest were taken for the first time in Philippine waters, though the presence of some had long been suspected; others were a complete surprise.

We now know enough about Philippine fishes and their distribution to state confidently that ultimately nearly all marine fishes recorded from the East Indies will be found in Philippine waters. We may be sure that all members of the following families known in East Indian waters will be collected in Philippine seas before many years: Clupeidæ or herring and sardines; all eels; pipefishes or Syngnathidæ; all flatfishes; cardinal fishes or Apogonidæ; Serranidæ or sea basses, lapo-lapo and their allies; snappers or Lutianidæ; all Pomadasyidæ or grunts; all lethrinids, sparoid fishes, besugo, and nemipterids; all butterfly fishes or Chætodonts; all surgeon fishes or Acanthurids and all siganids; all Scorpaenidæ or scorpion fishes; probably all labrids and parrot fishes, and all damsel fishes.

In addition, many gobies remain to be collected and made known to science from the tide pools, tide flats, mangrove and nipa swamps, from the sea below the depth of ten meters, and from the rivers and lakes.

With advancing knowledge, the Philippine fish fauna will be seen to be linked with that of China, Formosa, the Riu Kiu Islands, and Japan to the north, and to the East Indies, Indo-China, Siam, Malay, and India to the south and west; to the east, it will interlock with that of the Pelews, Waigiu, and the north shore of New Guinea, then southward with extensions throughout Melanesia and far into Polynesia, as well as to the northern end of Queensland, Australia.

All measurements are of the standard length.

Lanternfishes

Family MYCTOPHIDÆ

CENTROBRANCHUS ANDREAE (Lütken)

Scopelus (*Rhinoscopelus*) *andreæ* Lütken, Spolia Atlantica (1892) 245, *fig. 3*; Goode and Bean, Oceanic Ichthyology (1895) 90; Jordan and Evermann, Fishes North and Middle America 1 (1896) 569. Open Atlantic and Indian Oceans; "common in the Gulf Stream along our coasts."

Centrobranchus andræ Fowler, Mem. Bishop Mus. 10 (1928) 67. Hawaiian Islands.

The six species of lanternfishes here given, all new to the Philippines, were determined by Dr. Rolf L. Bolin, of the Hopkins Marine Station, Stanford University, California. Dr. Bolin has examined the types of lanternfishes in the museums of Europe and America, and is an authority on this group.

Two specimens, 45 and 50 mm. in length, were taken in the Sulu Sea near Tubataha Reef. This trim little fish with a noticeably elongate and slender caudal peduncle occurs in the open Atlantic, Indian, and Pacific oceans.

MYCTOPHUM AUROLATERNATUM Garman

Myctophum aurolaternatum Garman, Mem. Mus. Zool. 24 (1899) 264, *pl. 55, fig. 3*. Off Panama, 6°21′ N. Lat., 80°41′ W. Long.; Parr, Bull. Bingham Oceanogr. Coll. 3 (1928) 65. Eastern Pacific Ocean.

A Pacific Ocean species. An elongate slender swift species occurring off shore; taken at night by the aid of electric light. Our specimens are all from the Sulu Sea.

Three specimens 52 to 86 mm. in length taken about 30 miles west of Siokun Bay, Zamboanga Province, Mindanao, at 7° 45′

N. Lat., 121° 45′ E. Long. One specimen 78 mm. long was taken at 9° 31′ N. Lat., 119° 40′ E. Long. in the Sulu Sea, northwest of Tubataha Reef and about 75 miles east of Aborlan, Palawan. One specimen 87 mm. long, taken from the Sulu Sea northwest of the Cagayan Islands, at 9° 44′ N. Lat., 120° 58′ E. Long.; two specimens 78 and 89 mm. in length, near Tubataha Reef, at 8° 57′ N. Lat., 120° 15′ E. Long.

MYCTOPHUM BRACHYGNATHOS (Bleeker)

Scopelus brachygnathos Bleeker, Act. Soc. Sci. Indo-Neerl. 1 (1856) 65. Menado, Celebes; Bleeker, Nat. Tijds. Ned. Ind. 17 (1858–1859) 149. Bali.

Scopelus brachygnathus Bleeker, Versl. Akad. Amsterdam 14 (1862) 112. Batjan.

An East Indian and Philippine species. A specimen of this rather deep-bodied little fish, 61 mm. long, was taken in the Sulu Sea, near Tubataha Reef.

MYCTOPHUM EVERMANNI Gilbert

Myctophum evermanni Gilbert, Bull, U. S. Fish Comm. 23, part 2 (1905) 597, *pl. 70, fig. 2.* South of Oahu off Lanai Niihau Laysan; Gilbert, Mem. Mus. Comp. Zool. 26 (1908) 218 Lat. 5° to 17° N., Long. 135° to 137° W.; Marquesas Islands; Weber and de Beaufort, Fishes Indo-Austr. Arch. 2 (1913) 162, *fig. 63.* Halmahera Sea Banda Sea, Manipa Strait; Fowler, Mem. Bishop Mus., 10 (1928) 70. Hawaii; Parr, Bull. Bingham Oceanogr. Coll. 3 (1928) 65; Fowler, Monogr. Acad. Nat. Sci., Phila. 2 (1938) 152. Moorea, Society Islands; p. 187, Jarvis Island; p. 192, Christmas Island.

From the Hawaiian and Marquesas Islands to the Philippines and East Indies.

Two specimens were collected in the Sulu Sea, west of Siokun Bay, Zamboanga Province, Mindanao, at Lat. 7° 45′ N., Long. 121° 45′ E. Their lengths were 42 and 78 mm. Another specimen 69 mm. long was taken off the north coast of Celebes, in the Celebes Sea.

MYCTOPHUM MARGARITATUM Gilbert

Myctophum margaritatum Gilbert, Bull. U. S. Fish Comm., 23 part 2, (1905) 596, *pl. 68, fig. 2.* Off Molokai, Lanai, Oahu, and Niihau, Hawaiian Islands, French Frigates Shoal, between Honolulu and San Francisco.

A lantern fish of the tropical Pacific. Four specimens from the Gulf of Davao, Mindanao, are 31 to 56 mm. in length. Four from Zamboanga are 58 to 61 mm. An example 46 mm. long was taken in the Sulu Sea at 7° 45′ N. Lat., 121° 45′ W. Long., approximately 30 miles west of Siokun Bay, Zamboanga

Province, Mindanao. Five specimens off Tubataha Reef are from 56 to 62 mm. in length, and fifteen taken near Tubataha Reef, at 8° 57′ N. Lat., 120° 15′ E. Long., are 22 to 66 mm. An example 63 mm. long was secured from the Sulu Sea east of Palawan, 9° 31′ N. Lat., 119° 40′ E. Long. Four were taken in the Sulu Sea northwest of the Cagayan Islands, 58 to 66 mm. in length. One 55 mm. long was collected at Gutob Anchorage on the north coast of Busuanga.

MYCTOPHUM SPINOSUM (Steindachner)

Scopelus spinosus Steindachner, Sitzungsber. Akad. Wiss. Wien **55** (1867) 711, *pl. 3, figs. 4* and *a.* China Sea; Lütken, Dansk. Vid. Selsk. Skrift. 2nd ser. **7** (1892) 239, *pl. 1, figs. 1* and *2.* Malden Island, 4° 3′ S. Lat., 155° 1′ W. Long.

Myctophum (*Myctophum*) *spinosum* Brauer, Deutsche Tiefsee Exped., Tiefseefische (1906) 196.

Dasyscopelus spinosus Goode and Bean, Oceanic Ichthyology (1895) 92. Atlantic and central Pacific; Gilbert, Mem. Mus. Comp. Zool. **26** (1908) 220, 3° to 16° N. Lat., 135° to 149° W. Long; Fowler, Mem. Bishop Mus. **10** (1928) 67. Wake Island, Hawaiian Islands.

Myctophum spinosum Weber and de Beaufort, Fishes Indo-Austr. Arch. **2** (1913) 163. Celebes Sea, Ombai Straits; Parr, Bull. Bingham Oceanogr. Coll. **3** (1928) 63.

Known from the western and central Pacific, Indian and eastern Atlantic oceans.

Five specimens 71 to 81 mm. in length, taken from the Celebes Sea off the south coast of Tawi Tawi, Sulu Islands; 3 from 78 to 81 mm. in length caught in the Celebes Sea east of Tawi Tawi at 5° N. Lat., 121° E. Long. Two examples from the Gulf of Davao, Mindanao, are 72 and 74 mm. in length.

A specimen 80 mm. long was obtained off the Celebes coast at the north end of Makassar Strait. Seven examples, 74 to 82 mm. long, were caught off the east coast of Borneo, 3° 1′ N. Lat., 118° 49.5′ E. Long.

Flying fishes

Family EXOCŒTIDÆ

CYPSELURUS FURCATUS (Mitchill)

Exocœtus furcatus Mitchill, Trans. Lit. Philos. Soc. New York **1** (1815) 449. New York.; Günther, Cat. Fishes **6** (1866) 286. Atlantic ocean; India: Day, Fishes India (1878) 519; Jordan and Evermann, Fishes North and Middle America 1 (1896) 737; Günther, Fishe der Sudsee **3** (1909) 365, Tahiti; Beebe and Tee Van, Field Book of the Shore Fishes of Bermuda (1933) 68; Breder, Field Book of Marine Fishes of the Atlantic coast from Labrador to Texas, p. 96, figure, no date; Smith, J. L. B., Sea Fishes of Southern Africa (1949) 125, *fig. 211.* Indian, Atlantic, and central Pacific oceans.

The Philippine seas are rich in flying fishes, both in numbers of different kinds and in countless thousands of individuals. They are the object of special fisheries on the coasts of Cebu, Leyte, and other Visayan Islands.

Double-bearded flying fish. Originally described from New York, and known from the Atlantic, Indian, and Pacific Oceans. Now reported for the first time from the Philippines.

Dorsal 12 to 14; anal 10, 11, or 9; pectoral 1 to 14 or 1 to 13; predorsal scales 28 or 29. Two long ribbon-like barbels from the symphysis of the lower jaw. The ventral origin is midway between the caudal base and the middle of the eye; the anterior dorsal rays are shorter than the head, and both dorsal and anal usually fall short of the caudal when depressed; in the specimen from the Celebes Sea the dorsal is elevated, its height equal to the distance between the snout and the pectoral origin, and extending half the length of the upper caudal lobe.

The pectoral is black with a broad diagonal transverse white bar, or may be barred or mottled with black and white; the lower lobe of the caudal has one to three dark cross bands. The dorsal is more or less dusky or black, especially distally. The ventrals are nearly clear. Several broad blackish or dark brown bands were present on the sides and underneath, but these have largely disappeared.

A specimen 69 mm. long from the Celebes Sea east of Tawi Tawi, Sulu Province, at 5° N. Lat., 121° 4.5′ E. Long. Three specimens 58 to 82 mm. long were taken in the Sulu Sea northeast of Cagayan Sulu Island. Another example 98 mm. long was caught off the north coast of Celebes, 2° N. Lat., 121° E. Long.

These juvenile specimens are very attractive and unusual in appearance.

CYPSELURUS OXYCEPHALUS (Bleeker)

Exocœtus oxycephalus Bleeker, Nat. Tijds. Ned. Ind. 3 (1852) 771. Celebes; Bleeker, Atlas Ichth. 6 (1866–1872) 75, *pl. 248* (Scombresocidæ II) *fig. 1.* Batavia, Java, Makassar, Celebes; Günther, Cat. Fishes 6 (1866) 294. East Indian Archipelago, Formosa.

Exonautes oxycephalus Ogilby, Ann. Queensland Mus., No. 9, part 1 (1908) 5. Torres Straits.

Cypsilurus oxycephalus Weber and de Beaufort, Fishes Indo-Austr. Arch. 4 (1922) 181. Java, Java Sea, Celebes, Moluccas, Aru Islands, Torres Straits; Fowler, Mem. Bishop. Mus. 10 (1928) 81. Off Laysan Island, Apia, Samoa.

A tropical Pacific flying fish, now reported for the first time from the Philippines.

Three fine specimens, 172 to 180 mm. in length, were taken in the Sulu Sea off the west coast of Zamboanga Province, Mindanao, southwest of Panabutan Bay. One specimen, 130 mm. long, from the Celebes Sea, midway between the Samales Group, Sulu Islands, and Cotabato Province, Mindanao.

Dorsal 10 in all our specimens except one, which has but 9; according to authors 10 to 11. Anal 11 to 12; pectoral 1 to 14 or 15; scales in lateral line 52 to 54; predorsal scales 33 to 35. Teeth simple, in a single row in the jaws; none on the palate.

The anal origin is opposite, or nearly so, that of the dorsal, or may even be in advance of the dorsal origin. The pectorals extend to the posterior end of the dorsal base. The origin of the ventrals is slightly nearer the gill opening than to the caudal base. The pectorals are more or less blackish, the other fins colorless.

I place here also two specimens 134 and 137 mm. in length from the Sulu Sea west of Basilan Island and north of Pilas Island. They agree in most respects, but the pectorals have a partial hyaline transverse band on the lower part; Weber and de Beaufort speak of "an indication of a light transverse band", but this one is well developed as far as it extends; the ventrals and caudal are also definitely dusky. These specimens are much like Bleeker's figure of *Cypselurus speculiger,* but have no teeth on the palatines or vomer; the fin counts of dorsal and pectorals are wrong; and the scale counts are also wrong.

Another specimen 114 mm. long from the Celebes Sea, east of Tawi Tawi, Sulu Islands, probably belongs here. It has the color marks of *Cypselurus furcatus* and its ventrals are like those figured by Bruun, Dana Report No. 6, p. 58, plate 5, fig. 4, 1935. It has no teeth on the palate; the dorsal has 12, the anal 10 rays; pectoral I–13; predorsal scales 28; gillrakers 6+14. The anal origin is opposite the third dorsal ray.

While this specimen does not agree with the descriptions of Bleeker or of Weber and de Beaufort, it is evidently the same species as Fowler's juvenile specimen, which was only 42 mm. long.

CYPSELURUS SPILOPTERUS (Cuv. and Val.)

Exocœtus spilopterus Cuvier and Valenciennes, Hist. Nat. Poiss. **19** (1846) 113. Oualan, Caroline Islands; Bleeker, Atlas Ichth. **6** (1866–1872) 74, *pl. 250, fig. 2.* Gorontalo, Celebes.

Cypsilurus spilopterus Weber and de Beaufort, Fishes Indo-Austr. Arch., 4 (1922) 187. Five East Indian localities.

Cypselurus spilopterus Fowler, Mem. Bishop Mus. 10 (1928) 83. Hawaiian and Society Islands; Herre, Fishes Crane Pacific Exped., Zool. Ser. Field Mus. Nat. Hist. 21 (1936) 55. Between Makatea and Tahiti.

Exocœtus pœcilopterus (not of C. and V.) Day, Fishes India (1878) 518, *pl. 120, fig. 4*. Madras.

Found in the tropical Indi-Pacific as far east as the Hawaiian and Tuamotu Islands.

The pectorals are bluish dusky to black, with a broad diagonal white or colorless band on its lower two-thirds, the lower and posterior margin of the fin white or colorless; a few small circular and very black spots on the outer half, or elliptical or circular black spots may be sparingly and irregularly arranged in transverse bands; sometimes the white or hyaline cross band is but very little developed. Adult specimens have the caudal dusky, the other fins clear or the dorsal and ventrals may be more or less dusky or gray. A young specimen has the basal part of the ventrals and dorsal white, the outer three-fourths black; the anal has the distal portion of the middle and posterior rays dusky to black.

A specimen 243 mm. long from the market at Nasugbu, Batangas Province, Luzon; 2 from the Sulu Sea north of Pilas Island, their lengths 199 and 210 mm.; 2 from Sibutu Island, Sulu Province, 199 and 210 mm. in length; also one from the north coast of Celebes, 120 mm. long.

CYPSELURUS ZACA Seale

Cypselurus zaca Seale, Proc. Calif. Academy Sci., Fourth Series 21 (1935) 349, *pl. 21, figs. 1* and *2*.

The zaca flying fish. Previously known only from Fiji, Bellona Island in the Solomons, and Celebes.

One example of this strongly differentiated flying fish was obtained in the market at Batangas, Batangas Province, Luzon. Although only 32 mm. long, it cannot be confused with any other flying fish.

Dorsal 10; anal 8. The first, second, and third pectoral rays are all simple and much shorter than the other upper or median rays of the fin. Head 4.1, depth 5.3 times in the length. The eye is 2.1 in the head. The noticeably short snout is 3 times in the eye; the ventrals extend to the caudal base, their origin midway between the caudal base and the posterior margin of the opercle. The pectorals extend a little beyond the anal origin.

More or less pale silvery tan in alcohol, with minute black dots sprinkled over the body, especially on the under side; pectorals and ventrals black, the dorsal rays blackish on their outer half; and caudal colorless.

Mr. Seale's specimen from Fiji was 116 mm. long, and the one from Bellona Island was 142 mm. long.

EXOCOETUS VOLITANS Linnaeus

Exocœtus volitans L., Syst. Nat. ed. 10 (1758) 316. Atlantic Ocean; Weber and de Beaufrot, Fishes Indo-Austr. Arch. 4 (1922) 177, *fig. 62*. Java, Java Sea, west of Salayer; Fowler, Mem. Bishop Mus. 10 (1928) 80, *fig. 16*. Hawaiian Islands, Marcus Island, Wake Island, and other Polynesian localities; Herre, Fishes Crane Exped. Zool. Series Field Mus. Nat. Hist. 21 (1936) 53. Between Galapagos and Marquesas Islands, northeast of Raratonga, 100 miles west of Raratonga about 150 miles west of Fiji; Bruun, Dana Report No. 6 (1935) 28, *pl. 2*, *fig. 1*. Many localities in the Atlantic Ocean.

Occurs in all warm seas; largely pelagic and therefore not often seen along shore. No attempt is made to give the very extensive synonymy.

Sharp-finned flying fish. A specimen of this pan-tropic flying fish 157 mm. long was taken in the Sulu Sea, off the west coast of Zamboanga Province, Mindanao, not far from Santa Maria.

Dorsal 12; anal 12; pectoral I–14; lateral line 43. Ventrals equal to postorbital part of the head, the distance from their origin to the tip of the snout about two-thirds of the distance to the caudal base.

Color in alcohol blackish brown above (blue in life), silvery on the rest of the body; all fins blackish, the lower and posterior borders of the pectoral white.

Broad-forehead Flounder

Family BOTHIDÆ

CROSSORHOMBUS VALDE-ROSTRATUS (Alcock)

Rhomboidichthys valde-rostratus Alcock, Ann. Mag. Nat. Hist. ser. 6, 6 (1890) 435. Coast of Ceylon; Alcock, Illustr. Zoology *Investigator*, Fishes (1898) *pl. 24*, *fig. 2*.

Platophrys dimorphus Gilchrist, Marine Invest. S. Africa 3 (1905) 10, *pl. 27*. Natal, South Africa.

Scaeops kobensis Jordan and Starks, Proc. U. S. Nat. Mus. 31 (1906) 170, *fig. 2*. Kobe, Japan; Franz, Abhandl. Bayer. Akad. Wiss., Supplement 4, Abhand. 1 (1910) 61, *pl. 7*, *fig. 58*; *pl. 8*, *fig. 61*.

Engyprosopon kobensis Hubbs, Proc. U. S. Nat. Mus. 48 (1915) 458.

Crossorhombus dimorphus Regan, Ann. Durban Mus. 2 (1920) 212. Natal.

Crossorhombus valde-rostratus Norman, Rec. Indian Mus. 29 (1927) 28, *fig. 6*; Norman, Monogr. of the Flatfishes 1 (1934) 217, *fig. 166*. Off mouth of Umhlanga river, Natal, South Africa; North China;

Japan; coast of Ceylon; Hong Kong.

Engyprosopon valde-rostratus J. L. B. Smith, Sea Fishes of Southern Africa (1949) 159, *fig. 313*. Natal to Delagoa Bay.

A male specimen 145 mm. long was taken in the south entrance to Manila Bay, off the coast of Cavite Province, Luzon, Philippines.

Dorsal 96; anal 72; pectoral 1–12; the four upper rays elongate and filiform. Scales in lateral line 63, plus 3 more on the caudal base.

Depth 2.1, head 3.6, pectoral 3 in the length. Eyes very far apart in the male, the upper eye extending over the middle of the lower eye in my specimen; the longitudinal diameter of the eye 3.33 times in the head and 1.4 times in the interorbital space; snout less than the eye. Snout projecting, with a spine on its tip; a strong spine before the upper eye. Mouth strongly curved, the maxillary extending beneath the front rim of the lower eye, 3.2 times in the head. Seven gill rakers on the lower arch, none on the upper limb. Scales ctenoid on the colored side, cycloid on the blind side.

Color in preservative rather dark brown; a black spot on the posterior part of the lateral line from the fortieth to the forty-third scales, and traces of dusky spots scattered over the body; dorsal, anal, and caudal rays more or less spotted with darker brown.

Known from the coasts of Ceylon and Natal, South Africa, to Hong Kong and Japan.

PSEUDORHOMBUS ELEVATUS Ogilby

P. elevatus Ogilby, Mem. Queensland Mus. 1 (1912) 45. Moreton Bay, Queensland. Norman, Biolog. Results "Endeavour" 5 (1926) 234, *fig. 3;* Norman, Records Indian Museum 29 (1927) 15; Norman, Monogr. of the Flatfishes.

P. affinis M. Weber, Fische Siboga Exped. 57 (1913) 426, *pl. 11, fig. 1;* Weber and De Beaufort, Fishes Indo-Austr. Arch. 5 (1929) 110, *fig. 25.*

Deep flounder. Two examples, 141 and 151 mm. in length, were taken by beam trawl from Manila Bay, 10 miles northeast of Corregidor.

Dorsal 68 to 72; anal 52 to 54; left pectoral II–9 to 1; right pectoral II–8 or 9 to 1; lateral line 64 to 67 + 4 or 5 on the caudal base. Gill rakers 3 to 5 + 12 or 13. Depth 2 to 2.1, head 3.4 to 3.5 times in the length; eye 4.0 to 4.4 in the head, equal to or less than the snout; eyes separated by a narrow bony ridge, their anterior margins approximately even. Scales ctenoid on colored side, cycloid on the blind side.

Color in alcohol more or less mottled brown, with a large dark brown spot at the junction of the curved and straight parts of the lateral line; a similar blotch on the lateral line posteriorly, and traces of a third on the caudal peduncle. Dorsal, anal, and caudal rays with brown spots and dots.

Reaches a length of 150 mm. Occurs from the Persian Gulf to the Philippines, and south to tropical Australia.

PSEUDORHOMBUS QUINQUOCELLATUS Weber and de Beaufort

Pseudorhombus quinquocellatus Weber and de Beaufort, Fishes Indo-Austr. Arch. 5 (1929) 104. Norman, Monograph of the Flatfishes 1 (1934) 100, *fig. 61.*

Five-spotted flounder. A fine specimen 160 mm. long was collected in the south entrance to Manila Bay, Luzon.

Dorsal 67; anal 53; lateral line 76+3 on the caudal base; pectoral on colored side with 12 or 13 rays. Gill rakers 3+10.

Depth 2.19, head 3 1/3 times in the length; upper profile of head slightly notched before upper eye; snout a little longer than eye, which is 4.8 in the head. Lower eye very slightly in advance of the upper, the eyes separated by a narrow bony ridge. Maxillary extending beneath the posterior part of the eye, 2.19 in the head. Mouth large, prominent, with a small bony hump on the chin. Canines prominent, long, pointed, in both jaws, smaller posteriorly. A strong preanal spine, projecting through the skin. Scales ctenoid on the colored side, cycloid on the blind side.

Reddish brown in alcohol, with 5 large blackish ocelli, each with a pale brown ring about it; dorsal, anal, and caudal rays dusky brown.

A handsome fish. Previously known from 3 specimens 180 to 200 mm. in length, taken in Madura Strait and near the Kangeang Islands, East Indies.

Family SAMARIDÆ

SAMARISCUS SUNIERI Weber and de Beaufort

A specimen 81 mm. long was collected from Manila Bay, Luzon, by a beam trawler.

Dorsal 70; anal 60; scales in the lateral line 70. The depth is 3, the head 4.5, the pectoral 2.8 times in the length. The eye is 3.1, the maxillary 2.8 times in the head. The pectoral is very narrow, its longest ray filiform, 1.55 times the head.

Color dark brown, with 5 darker circular spots below the dorsal base and 4 near the anal base. Pectoral dark brown; distal half of the caudal dusky; a narrow dark border on dorsal and anal.

Weber and de Beaufort had 13 specimens from Nikolas Bay, Bali, and one from the sea north of Bali. Their largest specimen measured 136 mm.

Family CYNOGLOSSIDÆ

CYNOGLOSSUS OXYRHYNCHUS (Bleeker)

One specimen 120 mm. long was taken by beam trawl from Manila Bay.

Dorsal 104; anal 84; scales largely rubbed off on the colored side, but about 80; an upper and a median lateral line on the colored side, with 12 scales between them; a single lateral line on the blind side. Scales ctenoid on both sides.

Depth 4, head 4.6, caudal 12 times in the length; eyes 8, very close together, separated by a row of small scales, the upper in advance. Mouth reaches below hind margin of the lower eye, and is midway between the tip of the snout and the gill opening; hook of the upper jaw short, not extending below eyes.

Color above, in preservative, dark brown; where the scales are gone, reddish brown; under side pale; fins very dark brown.

Previously known from Java, Lombok, Borneo, and Amboina.

CYNOGLOSSUS SIBOGÆ M. Weber

A specimen 116 mm. long was taken near Corregidor off Cavite Province, in the south entrance to Manila Bay, in 31 fathoms.

Dorsal 100; anal 75; lateral line 68; two lateral lines on the colored side separated by 10 scales. Scales ctenoid on both sides, becoming larger posteriorly. Only a trace of a lateral line on the blind side.

Depth 3.8, head 5 in length; eyes 5 in the head, their inner rims pressed together, the upper one slightly in advance. The posterior nostril is between the eyes, the anterior one tubular, above the upper lip.

Color in alcohol brown, the fins darker brown; blind side paler.

This is the second Philippine record, one of 79 mm. having been obtained by the author in 1931, from the Gulf of Lingayen. Elsewhere known from Molo Strait and Salibabu Island, East Indies.

Family SYNGNATHIDÆ

TRACHYRHAMPHUS SERRATUS (Schlegel)

Syngnathus serratus Schlegel, Fauna Japonica, Poiss. (1847) 272, *pl. 120, fig. 4.* Nagasaki; Day, Fishes India (1878) 677, *pl. 173, fig. 4.* Very common at Madras.

Trachyrhamphus serratus Kaup, Cat. Lophobr. Fish (1856) 23. Weber and De Beaufort, Fishes Indo-Austr. Arch. 4 (1922) 99, *fig. 41.* Singapore, British India, Ceylon, Siam, China, Japan; Fowler, Hong Kong Naturalist 5 (1934) 317, *fig. 42.* Macao and Hong Kong, China.

This pipe fish, first described from Japan where it is common, occurs along the Asiatic coast south and west to India and Ceylon.

A good example of this large pipe fish, 189 mm. long was taken in the Sulu Sea, about 60 kilometers east of Puerto Princesa, Palawan.

The specimen has the dorsal 25; anal 3; pectoral 17; caudal 8; rings 23+50; subdorsal rings 3+3.

The head is 11 times in the length, the eye (small and sunken in the specimen) 9 in the head; in life much larger. Back and sides with small slender skinny appendages. The caudal fin is noticeably small, from a third to one-half as long as the snout.

Ground color tan, with about 10 broad brown cross bands; sides with pale or whitish spots.

This species reaches a length of 303 mm.

Family SCOMBRIDÆ

SCOMBEROMORUS GUTTATUS Cuv. and Val.

Scomber guttatus Bloch and Schneider, Syst. Ichth. (1801) 23, *pl. 5,* Tranquebar.

Cybium guttatum Cuvier and Valenciennes, Hist. Nat. Poiss. 8 (1831) 173; Günther, Cat. Fishes 21 (1860) 271. China, India, Malay Pen.; Day, Fishes India (1878) 255, *pl. 55, fig. 1* and *pl. 56, fig. 4.* Seas of India, Malay Archipelago, and China; Canara and Madras, India; Kishinouye, Journ. Coll. Agricul. 8 (1923) 419, *fig. 61.* Taiwan.

Spotted Spanish Mackerel; Spotted Seer; Spotted Tangingi.

Coasts of India, Malaya, East Indies, China, Formosa, Australia.

Dorsal XVI–I–19–IX; anal 20–VIII. The depth is 5, the head 3.95 times in the length; the eye is 6.38, the snout 2.59 in the head.

In alcohol the color is dark bluish above, bluish brown with a silvery glint along the sides; a row of rounded blackish spots along the lateral line, and below it, 2 rows of similar spots forming parallel rows, with a fourth incomplete row still lower down.

A very handsome fish in life. One specimen, 328 mm. long was taken at Guinlo, Malampaya Sound, Palawan. I had long believed this species occurred in Philippine waters, and was therefore much pleased to collect it. Like *Scomberomorus commerson* or Tangingi, it is a fine game fish of first class quality. From tangingi it is separated at once by the longitudinal rows of spots.

Family PEMPHERIDÆ

PEMPHERIS SCHWENKI Bleeker

Pempheris schwenki Bleeker, Nat. Tijds. Ned. Ind. 8 (1855) 314. Batu Island; Bleeker, Atlas Ichthyology 9 (1877) 8, *pl. 383, fig. 3.* Batu Island, Trussan, Sumatra; Barnard, Ann. S. African Mus. 21 (1927) 667. Natal Coast, South Africa; Weber and de Beaufort, Fishes Indo-Austr. Arch. 7 (1936) 219.

Thirty-three specimens, 28 to 42 mm. in length, were taken from a coral reef at Dumaguete, Negros Oriental Province.

Dorsal VI–9; anal III–37 to 38; scales in the lateral line 46 to 48.

These juvenile specimens are a very pale silvery tan, with darker vertical streaks; a band of melamophores along the middle of the back, and another on each side of the anal base; the dorsal and caudal fins more or less dusky; a dusky patch at the ventral base.

Family GEMPYLIDÆ

EPINNULA ORIENTALIS Gilchrist and Von Bonde

Epinnula orientalis Gilchrist and Von Bonde, Fisheries and Marine Biol. Survey, Report 3, Special Report VII (1924) 15, *pl. 4, fig. 1.* Off Natal Coast and Delagoa Bay; Barnard, Ann. S. African Mus. 21 (1927) 790; Kamohara, On the Offshore Bottom Fishes of Prov. Tosa, Ssikoku, Japan (1938) 20. Smith, J. L. B., Sea Fishes Southern Africa (1949) 311, *fig. 865.* Off Natal and Delagoa Bay.

Known previously only from Natal and Delagoa Bay, South Africa and Japan.

A specimen 156 mm. long was taken in a deep-water fish corral at Barrio Butong, Taal, Batangas Province, Luzon.

Dorsal XVI–I–19; anal III–18; depth 4.5, head 3.25 times in the length; the eye is 5 1/3 times in the head and twice in the snout. There are two lateral lines, both starting at the upper angle of the gill opening. The upper one runs near the dorsal, descending to end on the caudal peduncle, scales 86 in our specimen; the other line descends near the gill opening and beneath the pectoral, with about 30 scales; the lower line is very near to and follows the ventral outline, ending at the middle of the caudal, scales about 115. Scales small to very small and deciduous so that the specimen is practically naked; scales apparently with a silvery lustre. Three very large canines at the front of the upper jaw. Lower jaw projecting, with a pair of much smaller symphysial canines. A single row of sharp pointed teeth in the jaws.

Color in preservative dark brown to chocolate brown, the spinous dorsal black.

This rare fish is readily recognized by its double lateral line. It reaches a length of about 230 mm. Elsewhere it is only known from depths of 150 to 300 fathoms.

Family LUTIANIDÆ

LUTIANUS EHRENBERGI (Peters)

Mesoprion Ehrenbergi Peters, Monatsber. Akad. Berlin (1869) 704.

Diacope Ehrenbergi Klunzinger, Verh. Sool.-bot. Gesells. Wien **20** (1870) 701. Red Sea.

Lutjanus oligolepis Bleeker, Verh.Akad.Amsterdam; Revision Lutjanus **13** (1873) 17; Bleeker, Atlas Ichthy. **8** (1876-77) 48, *pl. 333, fig. 5*. Sumatra, Java, Celebes, Ternate, Amboina.

Lutjanus Ehrenbergi Weber and de Beaufort, Fishes Indo-Austr. Arch. **7** (1936) 242. Ten East Indian localities. Also east coast of Africa; Sokotra; Formosa; New Ireland; New Britain; Solomon Islands.

A handsome snapper known from the east coast of Africa to Formosa and the Solomon Islands.

A fine example 239 mm. long was collected at Guinlo, Malampaya Sound, Palawan.

Dorsal X–13; anal III–8; lateral line scales 48, plus 6 or 7 on caudal base; 6 above and 16 below lateral line. Form moderately robust with elevated dorsal profile, the depth 2.74, head 2.68 times in the length; the anterior profile is a nearly straight line; eye in anterior half of head; 5.2 times in head or 1.76 in snout. The posterior end of the maxillary almost reaches a vertical from centre of eye. Outer row of teeth in each jaw large and pointed with a pair of strong canines above anteriorly and lateral canines in the lower jaw. Interorbital naked, scales beginning on nape. Five rows of scales on preopercle, its lower border strongly denticulate; no preopercular notch, merely a shallow curve in its hind border.

The longitudinal rows of scales, both above and below the lateral line, run parallel to the body axis. Dorsal spines strong, fourth one longest; dorsal rays rounded and higher than the spinous part; anal spines robust, the anal rays much higher than the spines. Pectoral somewhat pointed, as long as distance from the posterior nostril to the end of the opercular flap; caudal approximately truncate.

Color in alcohol warm brown, each scale (except on the belly) with a darker to very dark brown spot, these spots forming strongly marked longitudinal rows, those above the lateral line darkest; a large dusky brown spot lying on, but mostly above, the lateral line and beneath the posterior end of the spinous dorsal and origin of the soft dorsal. In certain lights the spots on the scales have a silvery gleam and on some specimens the spots are clearly silvery; fins all unmarked, clear tan or yellowish.

This fish has been confused with *Lutianus fulviflamma* by a number of authors, but it is markedly distinct from that species. In *L. fulviflamma* the longitudinal rows of scales above the lateral line are oblique, rising to the dorsal profile, while the greater part of the lateral blotch is below the lateral line.

SYMPHYSODON TYPUS Bleeker

Symphysodon typus Bleeker, Arch. Neerl. Sci. Nat. **13** (1878) 61. New Guinea; Weber and de Beaufort, Fishes Indo-Austr. Arch. **7** (1936); Fowler, Mem. Bishop Mus. **10** (1928) 186. Descr. based on *Rhyacanthias carlsmithi* Jordan.

Propoma roseum Günther, Challenger Reports, Zool. **1** (1880) 39. Off Ki Islands, in 129 fathoms. Shore Fishes, *pl. 20, fig. B.*

Rhyacanthias carlsmithi Jordan, Proc. U. S. Nat. Mus. **59** (1921) 647, *figs. 3–4.* Hawaii.

A rare fish, whose presence in Philippine waters was unexpected. Six specimens, 50 to 80 mm. in length, were taken by beam trawl in 65 fathoms of water off the coast of Cavite Province, Luzon, in the south entrance to Manila Bay. This species reaches a length of 210 mm.

Dorsal IX–10; anal III–7; tubulated scales in lateral line 46 to 50, plus 3 to 8 more on the caudal base. The body and head are covered above, on the sides, and below with small ctenoid scales which extend almost to the very tip of the snout; the maxillary and mandible are also scaled.

Depth 3.72 to 3.65, head 2.9 to 3, the caudal 2.8 times in the length; the large eye is 2.9 to 3 times in the head, and is much longer than the snout.

The form is elongate, moderately compressed, the caudal large, long, and deeply cleft, its attenuate lobes with filamentous tips. The snout is rather blunt, the mouth of moderate size, the jaws sub-equal, the maxillary extending to or nearly to a point below the centre of the eye. The teeth are minute, the palate without teeth. The suborbital is very narrow, the end of the maxillary very close to the eye. The preopercle has a comparatively strong flat spine at its posterior angle; the posterior edge of the preopercle is minutely denticulate, though it requires the use of a powerful lens to show it on some specimens; a strong flat opercular spine behind the central part of the eye, and a much smaller flat diverging spine above it.

Our specimens were roseate in life, turning to dull reddish brown in preservative. Thinly sprinkled over the sides are black circular dots.

The fins, evidently clear red in life, are colorless to pale tan.

Family POMADASYIDÆ

SCOLOPSIS ERIOMMA Jordan and Richardson

Scolopsis eriomma Jordan and Richardson, Mem. Carnegie Museum 4: 188, *pl. 70, 199;* Takao, Formosa; Jordan and Starks, Annals Carnegie Mus. 11: 451, Ceylon; Fowler, U. S. Nat. Mus. Bull. 100, pt. 11 (1931) 273. After Jordan and Richardson.

Two examples were taken in the south entrance to Manila Bay, off the coast of Cavite Province, at a depth of about 70 fathoms. Their lengths were 94 and 111 mm.

Dorsal X–9; anal III–6; lateral line 35 or 36, 3 above and 11 below; 13 predorsal scales; 4 rows on the preopercle, the preopercular flange naked.

The depth is 2.9, the head 2.75 to 2.85, the caudal 4 to 4.5 times in the length. The large prominent eye is 2.5 to 2.8 times in the head, longer than the snout which is 1.44 to 1.5 times in the eye; the interorbital space is less than the eye. A small spine on the suborbital beneath the centre of the eye. Gill rakers 5 or 6 + 5, those on the lower limb short, stout, their summits more or less enlarged.

Color in preservative pale yellowish brown, with traces of 4 broad dusky crossbands from the dorsal base to the middle of the body; the first is predorsal, the second below the seventh to tenth dorsal spines, the last below the last rays of the soft dorsal, the fourth one at the posterior end of the caudal peduncle. The second band is reflected upon the fin above it; fins otherwise all clear.

These specimens agree sufficiently with Jordan and Richardson's description and figure, but present a few strong differences. The original description and figure cited above do not agree and there is one serious discrepancy. The scales are given as

48, but the figure shows nothing like that number, while further on, the description in speaking of the lateral line says "pores thirty-five", the figure agreeing.

The Formosan specimens were more than twice as large as those taken off the mouth of Manila Bay, and measurement differences are to be expected. But another discrepancy is not to be explained readily. The original description states "gill-rakers eleven on lower limb of outer arch, their length about half that of the corresponding filaments; the larger rakers terminating in a flattish, disk-like expansion, which is fringed."

From my esteemed friend and scientific colleague, Professor Tokiharu Abe, of the Imperial Fisheries Institute, Tokyo, I received a consignment of fishes for identification. Among them I found a specimen of *Scolopsis eriomma,* collected in Kochi Prefecture, Shikoku. Many tropical fish are taken in that prefecture, as the Kuro-Shiwo flows near its coast.

Length 115 mm; depth 2.73, head 3.1 times in the length; eye 2.64, snout 4.11 times in the head. The interorbital breadth is nearly equal to the eye, and the snout is 1.55 times in the eye. Gill rakers 6 plus 10, tips more or less pointed, their outer half minutely fringed; length of gill rakers about one-third that of the gill filaments. The fins and scalation agree with the Philippine specimens. It is evident that the scalation was incorrectly given in the original description. It is also evident that the gill rakers elongate and become more numerous as maturity is approached.

Family CLINIDÆ

CRISTICEPS XANTHOSOMA (Bleeker)

Clinus xanthosoma Bleeker, Nat. Tijds. Ned. Ind. 13 (1857) 340. Karangbollong, South Java.

Cristiceps xanthosoma Günther, Cat. Fishes 3 (1861) 273. After Bleeker; Herre, Philip. Jour. Sci. 59 (1936) 371. Reef at Paraoir, La Union Prov., Luzon; Herre, Philip. Jour. Sci. 70 (1939) 321. Same specimen, 61 mm. long.

Only known from Java and the Philippines.

A handsome specimen 51 mm. long was collected from the coral at Dumaguete, Negros Oriental Province. First dorsal III; second dorsal XXVII–4; anal II–20. The color is a clear beautiful golden yellow.

The specimen agrees with the descriptions cited above. This fish hides in the heads of living coral and is therefore practically never seen. This is the second Philippine collection, and the third record published.

Family OGCOCEPHALIDÆ

HALIEUTÆA STELLATA (Wahl)

Lophius stellatus Wahl, Skyr. Nat. Kjöb. 4 (1947) 214, *pl. 3*, *figs. 3* and *4*. Japan.

Halieutæa stellata Cuvier and Valenciennes, Hist. Nat. Poiss. 12 (1887) 456 (340), *pl. 366*. China; Schlegel, Fauna Japonica, Poissons (1846) 160, *pl. 72*. Nagasaki; Bleeker, Atlas Ichth. 5 (1865) 4, *plate 198*, *fig. 3* and *pl. 200*, *fig. 2*. Ceran, Japan; Day, Fishes India (1878) 273, *pl. 54*, *fig. 1*. Madras Jordan and Sindo, Proc. U. S. Nat. Mus. 24 (1902) 380. Coast of Japan; M. Weber, *Siboga* Exped. Fische 57 (1913) 566. Sapeh Strait, off New Guinea, off Timor.

A singular fish, growing to a length of 211 mm. or more. It is known from India to the East Indies, China, and Japan, and is now reported from the Philippines. It lives on the bottom at depths of about 50 to 300 meters.

A specimen 95 mm. long and with a breadth of 77 mm. was taken from the China Sea, off the coast of Batangas Province, northwest of Fortune Island, at a depth of 65 fathoms.

The head is very large and broad, its anterior and lateral margins forming a nearly circular and much depressed disk made up of the fused head and body. The upper surface is covered with weak simple straight spines; along the margin of the disk are bony prominences ending a group of 2 to 5 hard spines of a somewhat stellate appearance; a row of similar but much softer spines runs down each side of the tail. The underside is granular, without spines except along the margin of the disk and on the mandible.

The mouth is wide, horizontal; above it is a cavity containing a stout retractile tentacle with a somewhat trifoliate tip. The gill openings are far back on the upper surface, near the pectoral axillae. The small dorsal is on the tail beyond the disk, and is in advance of the slightly larger anal.

The color in alcohol is pinkish or slightly reddish brown.

SUMMARY OF THE GEOLOGY OF THE MALANGAS-SIBUGUEY COALFIELD, ZAMBOANGA PROVINCE, MINDANAO[1]

By Glen Francis Brown
Geologist, U.S. Geological Survey

SIX TEXT FIGURES

INTRODUCTION

Coal on the Sibuguey peninsula, Mindanao, (Fig. 1) has been known at least since 1855. During the period 1918–1930 about 113,500 long tons were mined from the east side of the peninsula. Prior to World War II the peninsula was studied geologically as part of the Philippine Government's economic development program. As a result of the study a road was built into the center of the peninsula (Fig. 2) and two new areas were opened. About 3,000 tons of high volatile bituminous coal had been shipped to Malangas prior to December, 1941.

In view of the continued failure to find substantial oil reserves in the Philippines, the good quality of the coal, and the geological complexities of the deposits, the area may deserve some description, even though the deposits are small.

The writer acknowledges with gratitude the help of his former colleagues of the Philippine Bureau of Mines, especially the late Dr. H. Foster Bain, Russell Fleming, and Mariano Melendres. Carle H. Dane kindly gave constructive criticisms and the U. S. Geological Survey prepared the final maps.

STRATIGRAPHY AND IGNEOUS ROCKS

Local formational names are used as the region is largely isolated from other areas where the age relations have been determined.

The oldest rocks on the peninsula, the Mount Kaladis quartzite (Table 1), are a complex of siliceous metamorphosed rocks the bulk of which is quartzite, hard siliceous breccia, and vein quartz. Sericite quartz schist and talcose rocks are also exposed within the complex. The quartzite is exposed on the upper slopes and crest of Mount Sibuguey. Similar rocks are exposed on the Pablo Peñas range some 75 kilometers west on the Zamboanga peninsula. Many well-rounded pebbles of jasper and vein quartz derived from Mt. Kaladis rocks are found in the Miocene sediments, so that the Mt. Kaladis quartzite is definitely pre-Miocene and is probably pre-Tertiary in age. Similar beds of siliceous rocks described as of pre-Tertiary age occur to the southwest in Borneo.[3]

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[1] Published with the permission of the Director, Philippine Bureau of Mines and the National Development Company.

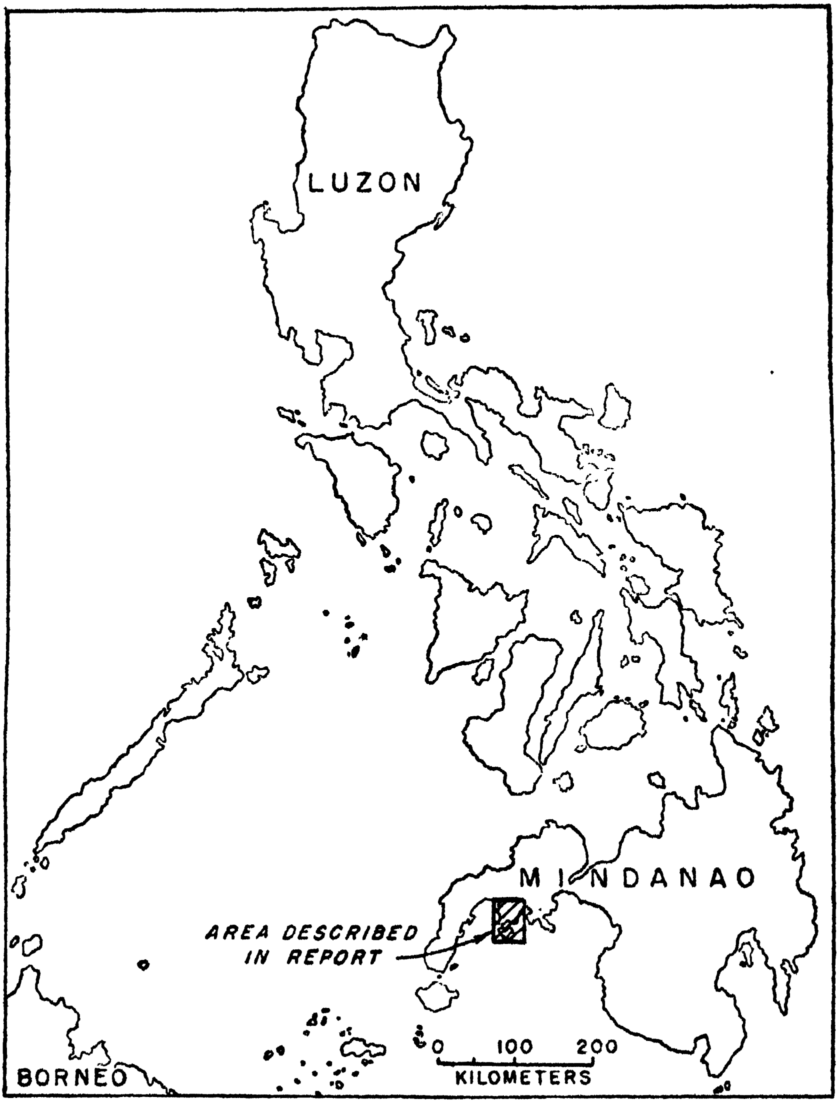

FIG. 1. Map of the Philippines showing the location of the area described.

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[3] Redfield, A. H. Petroleum in Borneo. Econ. Geol. 17 (1922) 313-439.

The oldest beds of Tertiary age are the marine limestones and shales of the Sibuguey formation. It is considered to be of Miocene age because the conformably overlying coal beds contain Miocene guide fossils. The lower thin-bedded shales grade upward into calcareous shale and limestone along the flanks of the upper Sibuguey valley and locally the beds are sandy. Nearly everywhere the Sibuguey formation is indurated by dynamic metamorphism, and locally hornfels, slate, and marmorized limestone are exposed near igneous intrusives. An estimate of the thickness of the sediments is difficult because of their disturbed position, but at the type locality near Tinotungan, 166 meters were measured.

TABLE 1.—*Summary of the stratigraphy of Sibuguey Peninsula*

System and series	*Formation*	*Description*	*Thickness*
Quaternary		Residual clays. Cover extensive areas and vary in thickness with the topography and the nature of the bed rock.	Not determined, but probably ranges from 0 to 15 meters.
		Stream-laid sediments. Thin veneers of clay, silt, sand, and gravel that thicken in the Sibuguey River Valley.	Not determined, but probably ranges from 0 to 150 meters.
		Coastal plain deposits. Living and dead coral reefs, deltaic alluvium and littoral debris.	
		Unconformity	
Tertiary Pliocene (?)	Caloi tuffaceous sediments.	Largely waterlaid tuff, tuffaceous clay shale, tuffaceous sandstone and conglomerate.	About 50 meters exposed at type locality.
Miocene	Lalat formation.	Shale, coal, and sandstone in alternating beds with sandstone predominating at top.	About 226 meters exposed at type locality.
	Sibuguey formation.	Shale, locally arenaceous, and limestone.	166 meters exposed near Tinotungan.

Unconformity

Pre-Tertiary (?)	Mount Kaladis quartzite.	Basement complex mostly quartzite but containing vein quartz, sericite-quartz schist, breccia, and talcose igneous material.	Unknown.

The coal-bearing beds are named from Lalat Creek, a tributary of the Sibuguey River, in the northwestern part of the peninsula. At the creek about 200 meters of the alternating beds of sandstone, shale, and coal are exposed. The areas of outcrop of the Lalat formation are scattered throughout the peninsula (Fig. 2). Most of them are small and isolated by igneous and metamorphic rocks. The Lalat formation apparently conformably overlies the marine limestone of the Sibuguey formation and disconformably underlies the Caloi tuffaceous sediments.

The coal seams are found at several stratigraphic postions within the Lalat formation. Perhaps the most important beds are near the base, and include the seams mined at Butong, near the east coast north of Malangas, the 4-meter coal at Lumbog, and the seams exposed at the northern and southern edges of the Lalat area. A bed of coal over a meter thick lies about 175 meters stratigraphically above the lowermost seams at Lalat and a coal high in the section was once mined at Gotas, near Butong. But apparently there is no widespread zone above the basal beds.

The sandstone beds in the Lalat formation are arkosic and locally contain pebbles and coarse grains of quartz and quartzite. At Lumbog most of the upper 200 meters of the sediments is composed of cross-bedded sandstone containing silicified logs. The marked disconformity at the top of the Lalat formation and the widespread distribution of fossilized wood where the Lalat formation is now absent, suggest that the upper part of the formation was largely sandstone which has been removed by erosion since Lalat time.

The shale beds are more uniformly thin-bedded than those of the Sibuguey formation from which they may also be distinguished by being slightly less indurated, and by containing abundant leaf imprints and invertebrate fossils of brackish water characteristics. Many of the leaf imprints cannot be distinguished in form from the leaves of the dipterocarpus trees growing on the outcrops at the present time. The fossils identified by Mr. José Barcelon from shales near the middle of the section at Lalat and Lumbog include *Vicarya callosa, Cerithium herklotsi, C. kenkinsi, C. bandongensis,* and *Terebra bicincta,* forms considered index fossils for the Miocene.[4]

The Caloi formation disconformably overlies the Lalat coal series. The beds are generally nearly flat except for local slumping and are composed of tuffaceous sediments associated with the post-Miocene vulcanism of the peninsula. The section along Caloi Creek at Lalat shows most of the various types of clastics found in the outcrops of the formation elsewhere. The tuffaceous beds range from fine-grained clays and shales to coarse conglomerate and, near vents, to agglomerate and tuff. All are deeply weathered. At Caloi Creek the measured thickness of about 50 meters increases rapidly northward. The age of the sediments cannot be definitely stated as no fossils other than non-diagnostic leaf imprints were found. Although a Pliocene age agrees with the age of vulcanism elsewhere in the Philippines[5] and in the Dutch East Indies,[6] the beds could be late Miocene, Pliocene, or Pleistocene.

Various younger deposits cover the coal-bearing beds. These include andesite and basalt flows and intrusives, river alluvium, and elevated coral reaf, besides widespread residual clay. The igneous rocks are nearly all andesite and basalt, although some outcrops, as at Deplahan are of coarser-grained diorite and gabbro. The smaller intrusives are porphyritic basalt, augite or hornblende andesite, and at least one was identified by Mr. Barcelon of the Philipine Bureau of Mines as dacite porphyry.

STRUCTURE AND GEOMORPHOLOGY

The Sibuguey peninsula lies between two tectogenes, or belts of down buckling in the earth's crust and is part of a zone where orogenic disturbances have been active at least since mid-Mesozoic.[7]

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[4] DICKERSON, R. E. A fauna of the Vigo group; its bearing on the evolution of marine molluscan faunas. Philip. Jour. Sci. 18 (1921) 1–19.

[5] SMITH, W. D. Contribution to the stratigraphy and fossil invertebrate fauna of the Philippine Islands. Philip. Jour. Sci. 8A (1913) 235–295.

[6] WESTERVELD, J. Tin ores of Banca, Billiton, and Singkep. Econ. Geol. 32 (1937) 1031.

[7] HESS, H. H. Major structural features of the western North Pacific an interpretation of H. O. 5485, Bathymetric Chart, Korea to New Guinea. Geol. Soc. America Bull. 59 (1918) 417–446.

The core of the peninsula is composed of andesite and related rocks and the Mount Kaladis quartzite (Fig. 2). The Sibuguey and Lalat formations are folded and faulted into isolated pockets scattered over the northern part of the peninsula, whereas the southern promontories and Olutanga Island consist of coral limestone recently elevated about three meters above the sea. The areas containing coal range in size from small inclusions in the igneous rocks to areas a few kilometers across. The larger areas of Miocene sediments are also the least metamorphosed, the most prominent feature being the raised rank of the coal. The shale, sandstone, and coal beds are folded and faulted into intricate and, in some places, chaotic patterns. Three of the coal outcrop areas are shown in Figs. 3 to 5. The present position of the coal beds can be ascribed to tectonic forces, largely acting horizontally; to landslides; or, as is more probable, to both. Areas of jumbled bedding lie near the top of the Lalat beds in Lumbog and Lalat. Such local jumbling plus the irregular surface of the Caloi-Lalat contact strongly suggests a terrain whereon landslides were common. The positions of some of the outcrops are due also to recent landslides which are common wherever shale crops out.

A prominent fault zone follows the east side of the Lutiman-Sibuguey valley. This zone is normal to much of the folding in the coal-bearing sediments where small scale faulting is also more or less of the tear variety. Later igneous activity, apparently along the zones of shear, has obscured somewhat the regional checkerboard pattern of east-west folds and north-south high angle faults.

The elevated position of the Mount Kaladis quartzite (595 meters above mean sea level) could be explained by overthrusting from the direction of the Moro Gulf. Several large boulders of vein quartz and quartzite are scattered over the southern part of the peninsula and locally lie on an upland plain as far north as Mount Tres Reyes. They may be lag boulders left during a beveling of the area east of the Sibuguey valley, in which case the Mt. Kaladis quartzite has been thrust over Tertiary sediments. If large thrusting came from the south, the peneplain-like surface so well developed across sediments and igneous rocks could be an exhumed over-thrust fault plane. This interpretation seems more logical than normal peneplanation and would explain the apparent anomalies of the coarse-grained basic igneous rocks penetrating the surface in the vicinity of Tres Reyes and the development of a peneplain across

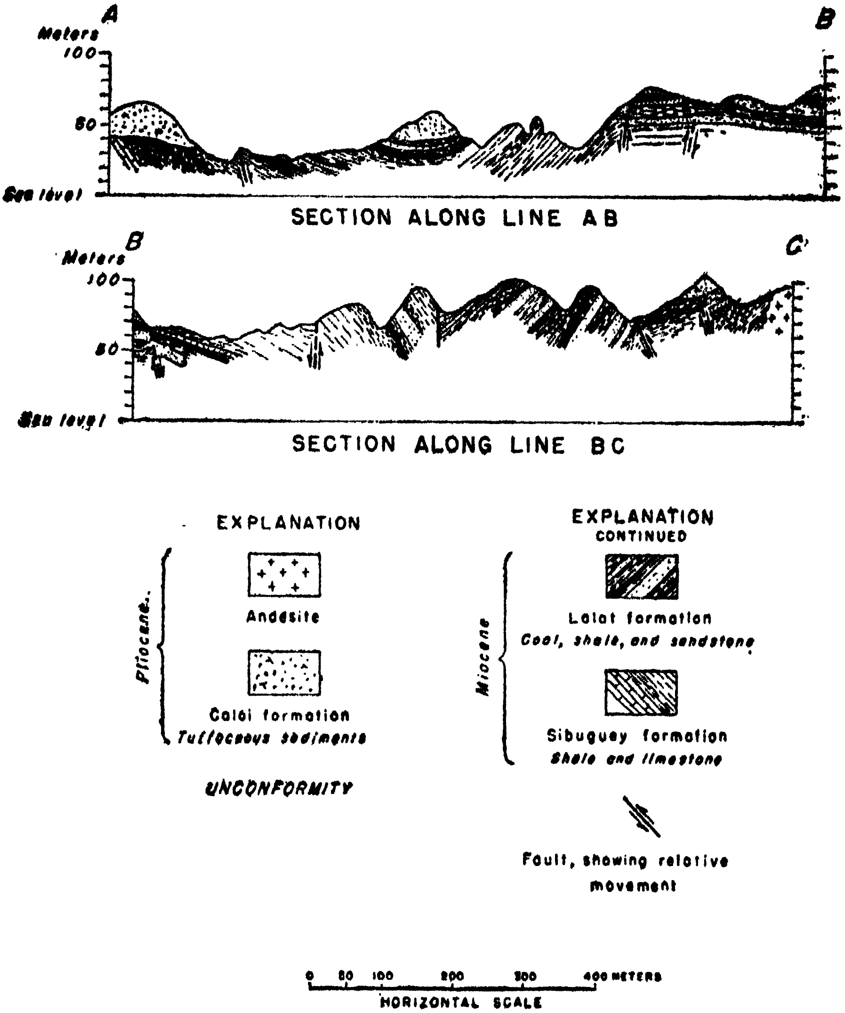

FIG. 6

soft tuffaceous sediments and quartzite. Recent northward tilting of the peninsula has caused drowned river-mouths on the northwestern and northeastern flanks, has elevated reefs on the southern promontories, and has forced the escape of the Sibuguey river westward from its old valley. Evidently compressive stresses are continuing from the south.

COAL

The various coal seams are classified as of bituminous rank according to the standards of the American Society of Testing

Materials.[8] The rank of coal from Lalat Creek is high volatile A and high volatile B, and considerably lower in ash than the Lumbog coal which is of the same rank (Table 2). The coal at Deplahan is low volatile bituminous, and contains erratic sulphur according to the samples. This coal is nearest large intrusive bodies and is probably the highest ranking in the district though of insufficient quantity for extensive mining operations (Fig. 3). Natural coke, or carbonite, exhibiting the typical columnar jointing, is exposed near the smaller sills. The most interesting feature of the coals is that all are of coking quality except the Deplahan samples according to tests made by the Cebu Portland Cement Company. Approximate analyses of typical samples of coal and some average thicknesses of coal seams are given in Table 2. Estimation of reserves is difficult because of the complexities of the geology. In the Lalat areas as much as 2 million tons of good coal may be mined, provided geologic conditions are studied and coal seams are followed in the development stages. Test drilling through the Caloi formation might substantially add to this figure.

CONCLUSIONS

High ranking bituminous coal has been formed from Miocene peat. The factors that may determine rank, namely time, nature of the coal-forming debris, heat, and pressure, can be partly evaluated. The beds containing coal have been folded and squeezed as well as sheared by faults. The time of coal formation is insufficient to be considered an important factor although the youthfulness of the deposits may explain why the rank has not reached anthracite. The depth of burial is of the order of hundreds of meters rather than thousands, judging from the known thicknesses of the Lalat and Caloi formations. The position between two tectogenes also suggests that a sedimentary accumulation of as much as 2,000 meters, as is reported in Borneo, is unlikely, and the numerous faults also indicate a rather shallow depth at the time of diastrophism. The rapid change in thickness along the strike does indicate some flowage and considerable depth but most of the changes seem to be due to original differences in amount of plant debris. The remaining factors, the heat and pressure of dynamic metamorphism and vulcanism seem to be the principal causes for the advance in rank.

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[8] **HENDRICKS, T. A. Recently adopted standards of classification of coal by rank and grade. Econ. Geol. 33 (1938) 136–142.**

TABLE 2.—*Proximate analyses of coal samples from Sibuguey Peninsula (plus sulfur and B.T.U. determinations)*

Coal-bearing locality	Seam	Average thickness	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	B. t. u.	Remarks
		Meters	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*		
Butong [1]	Lowest (?)	1.7	1.7	11.2	72.2	14.9	0.56	12,719	Air-dried basis, screened lump from shaft.
Lumbog [2]	Lowest exposed	3.5	2.65	32.82	54.29	10.24	0.65	12,776	Air dry moisture less per cent.
Lalat	Upper or No. 1	1.2	3.68	47.12	44.40	4.85	0.56	12,898	One parting 2 to 12 cm. thick near middle of seam.
Lalat	No. 3	0.96	2.41	45.00	42.60	9.99	2.91	12,444	140 to 166 meters stratigraphically below No. 1 coal.
Lalat	No. 4	2.0	2.40	46.82	48.20	2.58	0.53	13,325	12 to 20 meters below No. 3 seam.
Deplahan [3]	Upper of 2 seams	0.8	3.79	16.55	73.51	6.15	0.79	12,596	Near basic igneous intrusives.

[1] Analysed by National Coal Company.

[2] Analysed by Q. C. Olympia.

[3] Others analysed by E. R. Matute.

STUDIES ON THE CONTROL OF FECAL-BORNE DISEASES IN NORTH CHINA, XVI

AN APPROACH TO THE QUANTITATIVE STUDY OF THE HOUSE-FREQUENTING FLY POPULATION. D. THE BREEDING HABITS OF THE COMMON NORTH CHINA FLIES

By CH'ING HUA MENG AND GERALD F. WINFIELD

Cheeloo University, Department of Biology, Tsinan, Shangtung, China

THREE TEXT FIGURES

I. INTRODUCTION

In earlier papers of this series dealing with the quantitative study of the house-frequenting fly population (Meng and Winfield, 1941, 1941a, and 1942) a method of utilizing trapping for purposes of getting the fly population was developed and the results obtained when it was used in the study of an urban and a rural fly population were presented. Since a close correlation should exist between the density and breeding of a given fly population, the results of quantitative studies on fly breeding should closely fit and serve to explain quantitative information about fly density. One of the purposes of this paper, which reports studies on breeding habits of the common North China flies, is to show how quantitative data on breeding and density of population do correlate with one another.

Howard (1900), Howard and Bishop (1924), and Patton (1930), summarizing experiences chiefly gained in the U.S.A. and England, reported that *Musca domestica* breeds in horse manure in preference to any other medium though it uses a wide range of substances. Thomsen and Hammer (1936) did extensive observations in Denmark and found that *M. domestica* breeds most actively in pig manure in that country. These findings show that the breeding habits of a species may vary greatly in different countries or localities thus indicating the need for quantitative studies to further elucidate such variations. It is particularly desirable to use such methods in places not previously investigated.

Fly breeding studies in China date back to 1926, when Patton made some statements on the breeding habits of *Chrysomyia*

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* This study was financed by the Rockefeller Foundation.

megacephala in North China. In subsequent publications (1930 and 1933) he referred to the breeding habits of several other species of flies in China. Meng and Winfield (1938) published a preliminary report in which quantitative data on fly breeding in Tsinan were presented.

Quantitative studies on the breeding habits of house frequenting flies are a relatively recent development. Howard (1900) reported the results of an extensive series of breeding experiments with feces in the United States of America. As he used such terms as scarce, rather scarce, moderately abundant, etc., to indicate the suitability of feces for breeding different species, his work may be regarded as the first step in the development of the quantitative method. There was little advance in this direction until 1934 when Thomsen published the results of experiments carried out in Denmark. In his experiments sets of standard-sized containers filled with pig, horse, cow, and calf manure, were exposed for 24 hours either on a manure heap swarming with *Musca domestica* or in a calf shed where *Stomoxys calcitrans* was abundant. The manure was cultured and the flies bred out counted and classified. The mass culture method presented in this paper may be considered as a further step along this line.

II. MATERIALS AND METHODS

The data presented in this paper were derived from three types of observations: first, from a large series of mass cultures which were made to test the breeding and breeding habits of flies under natural conditions in the Tsinan area; second, from the examination of pig-pen-latrines *, which are commonly used for storing organic manure in rural districts in North China; and third, from laboratory experiments which were done to test the suitability of four types of media for breeding *Musca vicina*. The procedure used for each of these types of observations is hereby described.

The mass culture.—The procedure used in making mass cultures was similar to that described in our preliminary report (Meng and Windfield, 1938). In this study the method was improved in that a standard amount of about 650 cc. of material was used in each culture and samples were taken from each station at regular ten day intervals throughout the entire fly season from April to November 1936. The flies were bred, counted and identified as described in the earlier publication.

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* A typical pig-pen latrine consists of a resting place of the pig and a pit. The pit is used for storing different kinds of organic wastes from the family, such as pig manure, kitchen refuse, bran, rotten vegetables, etc. It is also used by members of the family as a kind of latrine. The organic wastes inside the pit are mixed with a large quantity of soil and water through the activities of the pigs. The soil compost thus manufactured is used by the farmers as a kind of fertilizer.

The types of media cultured and the stations from which they were collected were as follows:

Station 1. Liquid feces (a mixture of feces and urine) from a feces cake drying ground about half a mile to the south of the city.

Station 2. Liquid feces from a storage pit of the Agricultural Experiment Station south of the Cheeloo University campus, which is adjacent to the south suburb of Tsinan.

Station 3. Liquid feces from a private pit latrine in the South Suburb.

Station 4. Liquid feces from a private pit latrine near the center of the city.

Station 5. Solid feces from a private pit latrine in Chang Chia Chuang, a village about 1.5 miles south of the city.

Station 6. Solid feces from a public pit latrine in the South Suburb.

Station 7. Cow manure from a manure pile in the South Suburb.

Station 8. Cow manure from a manure pile in Chang Chia Chuang.

Station 9. Cow manure from the cow shed of the Composting Station at Hsin Chuang, a village about 5 miles west of the city.

Station 10. Cow manure from a dairy barn in Wang Chia Chuang, a village about half a mile south of the city.

Station 11. Pig manure from a pen-latrine in Chang Chia Chung.

Station 12. Pig manure from an abbatoir just outside the south gate of the city.

Station 13. Pig manure from the experimental pen latrine of the Composting Station at Hsin Chuang.

Station 14. Horse manure from a manure pile in the South Suburb.

Station 15. Horse manure from a manure pile in Chang Chia Chuang.

Station 16. Horse manure from the Composting Station, Hsin Chuang.

Station 17. Pen-latrine soil compost (a mixture of feces, different types of manure, vegetable wastes, and soil) from a pen-latrine in Chang Chia Chuang.

Station 18. Soil compost from the experimental pen-latrine at Hsin Chuang.

Station 19. City garbage from a garbage bin in the Cheeloo Medical School campus. The time schedule was not kept in this station so that the results obtained here cannot be used as those obtained from other stations.

In addition, cultures of decaying beef which was used in experiments on the food preferences of flies were also made. Since these cultures were not standardized as to quantity or time, the results are not comparable with those of other cultures.

Attention should be called here to certain limitations of the mass culture method as a means of determining the suitability and importance of the various breeding media in the production of the natural fly population. The first of these is that the number of flies bred out from the various cultures of the same medium or of different media will vary according to the number of egg-laying adults which come in contact with the different samples.

One, therefore, can not be too dogmatic in considering that this method gives an accurate picture of the relative suitability of the different media for the breeding of any species of fly. However, since each type of medium was collected from a number of stations consisting of a long series of cultures the results obtained should be reasonably reliable especially when their average is taken for comparison.

The second criticism arises out of the difficulty of sampling from large amounts of the media. This sampling problem is further complicated by the fact that maggots are not uniformly distributed through the breeding medium but tend to congregate in certain parts. This uneven distribution is a result of a number of factors such as the nature, temperature and quantity of the medium, light, moisture, and the age and structure of the maggot. For example, the larvæ of *Chrysomyia megacephala* and *Sarcophaga fuscicauda* are adapted to live in a liquid medium because the stigmal fossa of the former and the stigmal pit of the latter, are so constructed that the dorsal and the ventral lips can be so regulated as to protect the spiracular slits from being blocked by the liquid. While adapted to live in a liquid medium, nevertheless, these species congregate in the superficial layers because of the demands of respiration. In a liquid medium, therefore, the surface area is the important factor in determining the amount of breeding which may take place. In sampling liquid media the samples were taken from this layer in which the larvæ are most abundant. The role played by temperature of the medium and age of the maggot in determining distribution in other types of materials has been recently demonstrated by the Thomsens (1937). They found out that the prefered temperature is quite constant for larvæ of different species of different ages. For instance, in the first half of larval life, *Musca domestica* was found to congregate in areas with a temperature of 30° C to 37° C. The prefered temperature then falls gradually to below 15° C., upon reaching the prepupal stage. As the larvæ of most species are negatively heliotropic and that some species are sensitive to moisture, the effect of these factors in causing uneven distribution of larvæ within the medium is evident. Quantity of the medium may also affect the distribution because of temperature and moisture as it is evident that greater losses of heat and moisture occur in smaller than in larger heaps. It is clear, therefore, that the 650 cc. cultures used in the mass culture could not provide comparable samples from all types of media.

In spite of these sampling difficulties the mass culture method is still extremely useful in giving a more accurate picture of the actual amount and type of breeding which takes place under natural conditions in any given locality. Perhaps the best justification for concluding that this method is reliable comes from the fact, as will be shown below, that a high degree of correlation exists between the relative number of flies breeding in the different media during different months and the number of these flies present in the fly population.

Examination of latrines.—A half gallon of soil compost from the pen-latrines or of feces from the public latrines of Hu Chung P'o, one of the villages in the Lungshan Rural Area, was examined for larvæ, pupæ and pupal skins. Those found were counted and identified. The sampling difficulties in this type of examination are particularly great since the large amount of soil used in soil compost tends to make much of the material present in a pen-latrine unsuited for fly breeding, though there may be individual human or pig stools present which are breeding great numbers of flies. The data so collected, however, give valuable information as to the species of flies which breed in pen-latrines.

Laboratory experiments on the suitability of four types of media for breeding Musca vicina.—A series of ten experiments was done. In each experiment, standard size culture pans filled with solid feces of pig, horse and cow respectively were exposed for two days to a number of *Musca vicina* in a large cage. At the end of the exposure period the media were cultured. When the flies reached the third larval or the pupal stage they were killed and counted.

The results obtained by the use of the mass culture will first be presented after which the results of latrine examinations, and the series of laboratory experiments will be recounted.

III. PRESENTATION OF DATA

1. *Results obtained with mass cultures.*—The results obtained from the mass cultures will be presented in four sections. In the first section, the species make up of the flies breeding in each medium will be presented. In the second section, the relative suitability of the different media in breeding different species and groups of flies will be discussed. In the third section, the month by month variations of fly breeding during the fly season will be shown, while the fourth section will deal with the sex ratio of the flies bred.

In this paper the flies have been classified into four groups. The first two consist of single species, namely *Musca vicina* and *Chrysomyia megacephala.* The third group is made up of all the other species which are considered to be of public health importance. This group is indicated by the name *Other Species Group I* and is composed of *Muscina stabulans, Lucilia sericata,* and the various species of the genus *Sarcophaga.* The fourth group is designated as *Other Species Group II* and includes the common species of little or no public health importance. It should be noted that the *Other Species Group II* of this classification corresponds to the *Miscellaneous Species* which was included in the *Other Species Group* in the classification used in the paper on fly density in Tsinan and Lungshan (Meng and Winfield, 1941a, 1942).

A. SPECIES MAKE UP OF FLIES BRED IN EACH TYPE OF MEDIUM

A total of 394 cultures of eight types of natural breeding media taken from 19 stations and a series of feeding experiments as indicated in Table 1 were made. From these cultures a total of 21,664 flies was bred and classified. Table 1 shows the percentage belonging to each species of the total number of flies bred from each type of material during the entire

TABLE 1.—*Showing the percentage of flies belonging to each species or group bred out from mass culture of eight types of breeding material during April 13 to November 24, 1936.*

Type of medium	Pig manure	Solid feces	Liquid feces	City garbage	Horse manure
Stations	11–18	5–6	1–4	19	14–15
Number of cultures	59	44	68	10[1]	66
Total number bred out	7,759	3,342	2,752	329	516
Percentage belonging to:					
Musca vicina	36.0	17.1	2.5	43.5	90.3
Chrysomyia megacephala	0.0	4.8	80.9	41.3	0.0
Other Species Group I—					
Sarcophaga	14.8	28.2	15.4	3.4	0.8
Lucilia sericata	0.1	0.0	0.1	1.2	0.4
Muscina stabulans	0.0	5.6	0.0	0.3	0.0
Group total	14.9	33.9	15.5	4.9	1.2
Species important to health, Total	50.9	55.7	98.9	89.7	91.5
Other Species Group II—					
Musca tempestiva	0.0	0.0	0.0	0.0	0.0
Musca hervei	0.0	0.0	0.0	0.0	0.0
Stomoxys calcitrans	0.1	2.1	0.0	9.1	6.8
Stomoxys exigua	0.0	0.0	0.0	0.0	0.0
Aldrichiella and *Calliphora*	0.0	0.0	0.0	0.0	0.0
Musca autumnalis	0.0	0.0	0.0	0.0	0.0
Eristalis sp.	0.1	0.0	0.4	0.0	0.0
Unidentified species	48.9	42.2	0.7	1.2	1.7
Group total	49.1	44.2	1.1	10.3	8.5

Type of medium	Cow manure	Soil compost	Decaying beef	All types
Stations	7–10	17–18	--------	1–19
Number of cultures	83	44	20[2]	394
Total number bred out	2,667	59	4,240	21,664
Percentage belonging to:				
Musca vicina	0.9	15.2	0.0	18.8
Chrysomyia megacephala	0.0	0.0	1.0	11.8
Other Species Group I—				
Sarcophaga	0.1	6.8	65.8	24.6
Lucilia sericata	0.2	1.7	32.1	6.4
Muscina stabulans	0.3	5.1	0.0	0.9
Group total	0.6	13.6	97.9	31.9
Species important to health, Total	1.5	28.8	98.9	62.5
Other Species Group II—				
Musca tempestiva	60.8	0.0	0.0	7.5
Musca hervei	18.6	6.8	0.0	2.3
Stomoxys calcitrans	0.2	45.8	0.0	0.8
Stomoxys exigua	3.9	0.0	0.0	0.5
Aldrichiella and Calliphora	0.0	0.0	1.1	0.2
Musca autumnalis	0.3	0.0	0.0	0.1
Eristalis sp.	0.0	5.1	0.0	0.1
Unidentified species	14.7	13.5	0.0	26.0
Group total	98.5	71.2	1.1	37.5

[1] Cultures made during September, with cultures made during July and August 1937 included.

[2] Cultures made during August and September, not standard cultures.

season. A study of this table shows the species make up of the flies bred from each type of medium.

1. *Pig manure.*—More than 50 per cent of the flies bred from this material were of public health importance, among which *Musca vicina,* the most common (36 per cent), was over twice as numerous as *Sarcophaga* (14.8 per cent), while *Lucilia sericata* (0.1 per cent) was rare. *Stomoxys calcitrans* and *Eristalis sp.* combined comprised less than 1 per cent, while about 49 per cent were unidentified.

2. *Solid feces.*—Over 55 per cent of the flies bred from solid feces belonged to species of public health importance. *Sarcophaga* which comprised 28.2 per cent of the flies bred from this material was followed by *Musca vicina* (17.1 per cent), *Muscina stabulans* (5.6 per cent) and *Chrysomyia megacephala* (4.8 per cent). More than 2 per cent were *Stomoxys calcitrans,* while 42.2 per cent belonged to unidentified species.

3. *Liquid feces.*—Almost 99 per cent of the flies bred from liquid feces were of public health importance. *Chrysomyia* megacephala, the commonest (80.9 per cent), was more than 5 times as numerous as *Sarcophaga* (15.4 per cent), 32 times as numerous as *Musca vicina* (2.5 per cent), and 800 times as numerous as *Lucilia sericata* (0.1 per cent). *Eristalis sp.* (0.4 per cent) was bred in small numbers while less than 1 per cent was unidentified.

4. *Horse manure.*—Of the flies bred from horse manure, over 90 per cent were of public health importance. Among these *Musca vicina* was the commonest (90.3 per cent), while *Sarcophaga* (0.8 per cent) and *Lucilia sericata* (0.4 per cent) were rare. *Stomoxys calcitrans* comprised 6.8 per cent and 1.7 per cent were unidentified.

5. *Cow manure.*—Nearly 99 per cent of the flies bred from this medium belonged to *Other Species Group II,* while only 1.5 per cent were of public health importance. *Musca vicina, Sarcophaga, Lucilia sericata,* and *Muscina stabulans* occurred in small numbers. *Musca tempestiva,* the commonest species (60.8 per cent), was more than 3 times as numerous as *Musca hervei* (18.6 per cent) and 15 times as numerous as *Stomoxys exigua* (3.9 per cent). *Stomoxys calcitrans* and *Musca autumnalis* combined accounted for less than 1 per cent. About 15 per cent were unidentified.

6. *Pen-latrine soil compost.*—Less than 30 per cent of the flies bred from this material were of public health importance. *Musca vicina,* the commonest (15.2 per cent) of the flies

important to health, was more than twice as numerous as *Sarcophaga* (6.8 per cent) 3 times as numerous as *Muscina stabulans* (5.1 per cent), and about 9 times as numerous as *Lucilia sericata* (1.7 per cent). *Stomoxys calcitrans* (45.8 per cent) was the commonest species bred from this material. *Musca hervei* (6.8 per cent) and *Eristalis sp.* (5.1 per cent) were also found.

7. *City garbage.*—Almost 90 per cent of the flies bred from garbage were of public health importance. The commonest species were *Musca vicina* (43.5 per cent) and *Chrysomyia megacephala* (41.3 per cent), while *Sarcophaga* (3.4 per cent), *Lucilia sericata* (1.2 per cent), and *Muscina stabulans* (0.3 per cent) were rare. *Stomoxys calcitrans* accounted for 9.1 per cent while 1.2 per cent were unidentified.

8. *Decaying beef.*—About 99 per cent of the flies bred from beef were of public health importance. *Sarcophaga,* the commonest (65.8 per cent) was more than twice as numerous as *Lucilia sericata* (32.1 per cent), while *Chrysomyia megacephala* (1.0 per cent) was rare. *Aldrichiella grahami* and *Calliphora erythrocephala* were produced in very small numbers.

9. *All types of media combined.*—Of the total number of flies bred from all types of media over 60 per cent were of public health importance. The important species ranked as follows: *Sarcophaga* (24.6 per cent), *Musca vicina* (18.8 per cent), *Chrysomyia megacephala* (11.8 per cent), *Lucilia sericata* (6.4 per cent), and *Muscina stabulans* (0.9 per cent). Of the *Other Species Group II, Musca tempestiva* (7.5 per cent) and *Musca hervei* (2.3 per cent) were the commonest species, while each of the remaining species accounted for less than 1 per cent of the flies bred. Twenty-six per cent of the flies were unidentified.

B. THE SUITABILITY OF THE DIFFERENT MEDIA FOR BREEDING FLIES AS INDICATED BY THE AVERAGE NUMBER OF FLIES BRED PER CULTURE

The importance of any type of medium for breeding flies in an area is determined by the suitability and quantity of the medium for producing the species. A very suitable medium, judged by the number of flies it can produce per a given amount, may be unimportant in a region where it is present in small amount, while a relatively unsuitable medium may be important because it is present in a large quantity. The mean number of flies bred from the mass cultures made during the 1936 breeding season should indicate the relative suitability of the different media for producing the different species of flies (Table 2). The table indicates that the most suitable medium for producing all flies was pig manure (146.4) followed by solid feces (95.5), liquid feces (52.9), cow manure (36.0), garbage (32.9), horse manure (9.5) and soil compost (1.6).

The average number of flies of importance to public health bred per culture is shown on the mid line of the table with the media arranged in the order of their suitability from left to right. Pig manure is the most suitable medium for breeding this group of flies, while soil compost and cow manure are both relatively unsuitable since each gave an average of only 0.5 flies per culture. Pig manure produced about 1.5 times as many flies per culture as did solid or liquid feces, more than twice as many as did garbage, and about 9 times as many as horse manure. Solid and liquid feces were almost equal in their ability to breed flies that are important to health although the species differed in the two cases.

TABLE 2.—*Showing the mean numbers of each species or group bred per culture of different media during April 13 to October 15, 1936.*

Type of medium	Pig manure	Solid feces	Liquid feces	City garbage	Horse manure	Cow manure	Soil compost
Number of cultures	53	35	52	10*	55	74	37
Mean number per culture of:							
Musca vicina	52.6	16.3	1.3	14.3	8.5	0.3	0.2
Chrysomyia megacephala	0.0	4.6	48.2	13.6	0.0	0.0	0.0
Other Species Group I:							
Sarcophaga	21.8	27.0	8.1	1.1	0.1	0.1	0.1
Lucilia sericata	0.1	0.0	0.1	0.4	0.1	0.1	0.1
Muscina stabulans	0.0	5.3	0.0	0.1	0.0	0.1	0.1
Group total	21.9	32.3	8.2	1.6	0.2	0.2	0.3
Species important to health, Total	74.5	53.2	52.3	29.5	8.7	0.5	0.5
Other Species Group II:							
Musca tempestiva	0.0	0.0	0.0	0.0	0.0	21.9	0.0
Musca hervei	0.0	0.0	0.0	0.0	0.0	6.7	0.1
Stomoxys calcitrans	0.1	2.0	0.0	3.0	0.6	0.1	0.7
Stomoxys exigua	0.0	0.0	0.0	0.0	0.0	1.4	0.0
Musca autumnalis	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Eristalis sp.	0.1	0.0	0.2	0.0	0.0	0.0	0.1
Unidentified species	71.7	40.3	0.4	0.4	0.2	5.3	0.2
Group total	71.9	42.3	0.6	3.4	0.8	35.5	1.1
All flies	146.4	95.5	52.9	32.9	9.5	36.0	1.6

* Including 3 cultures made during July and August 1937.

In order to see clearly the part played by each type of medium in producing the four groups of flies, Table 3 was prepared. This table shows that *Musca vicina* was bred from all seven types of media. Pig manure produced the largest number per culture while solid feces, garbage and horse manure produced fair numbers. Liquid feces produced less than one

TABLE 3.—*Showing the ranking of the different media according to their suitability for breeding the four groups of flies as measured by the average number of each group bred from 650 cc. cultures.*

Rank	Medium	Mean number
	A.—*Musca vicina*	
1	Pig manure	52.6
2	Solid feces	16.3
3	Garbage	14.3
4	Horse manure	8.5
5	Liquid feces	1.3
6	Cow manure	0.3
7	Soil compost	0.2
	B.—*Chrysomyia megacephala*	
1	Liquid feces	42.8
2	Garbage	13.6
3	Solid feces	4.6
	C.—*Other Species Group I*	
1	Solid feces	32.8
2	Pig manure	21.9
3	Liquid feces	8.2
4	Garbage	1.6
5	Soil compost	0.3
6	Cow manure	0.2
7	Horse manure	0.1
	D.—*Other Species Group II*	
1	Pig manure	71.9
2	Solid feces	42.8
3	Cow manure	35.5
4	Garbage	3.4
5	Soil compost	1.1
6	Horse manure	0.8
7	Liquid feces	0.6
	E.—*All species of flies*	
1	Pig manure	146.4
2	Solid feces	95.5
3	Liquid feces	53.9
4	Cow manure	35.7
5	Garbage	32.9
6	Horse manure	9.4
7	Soil compost	1.6

tenth as many as did solid feces. Cow manure and soil compost were both quite inefficient in producing this species. Because of its abundance as well as a fairly high production per unit of volume, solid feces is probably the most important medium in the Tsinan area for producing *Musca vicina* which is the dominant species in houses.

Chrysomyia megacephala the dominant outdoor species during hot weather was bred from three types of material. By far the most efficient medium for this species is liquid feces. Garbage was able to produce fairly large number while a few was produced by solid feces. Because of its efficiency and abundance, after the beginning of the summer rainy season, liquid feces is by far the most important medium for the production of *Chrysomyia megacephala.*

Because both of the *Other Species Groups* include a number of species, they were bred from all types of media. Solid feces produced the largest number per culture of *Other Species Group I,* followed closely by pig manure, while the other media produced much fewer. The *Other Species Group II* was produced in large numbers in pig manure, solid feces and cow manure, while the other media produced only a few flies per culture.

This more extensive series of cultures confirms the conclusions reached in the preliminary study made in Tsinan (Meng and Winfield, 1938) that human feces both in the solid and liquid condition is the most important medium in producing flies. It also indicates that pig manure is a very favorable medium for breeding flies of all groups except *Chrysomyia megàcephala* and, when present in big quantity, is important in the production of the house frequenting fly population.

C. MONTH BY MONTH VARIATIONS IN BREEDING ACTIVITY OF THE FLY POPULATION

The mean number of flies bred per culture during each month of the fly season belonging to each species and group is shown in Table 4 and graphed in Figs. 1 to 8.

Musca vicina.—(Table 4 A, Fig. 1) This species was found breeding in one or more media during the months of June to October inclusive. The breeding in cow manure and soil compost was so slight as to be negligible. The breeding in horse manure did not reach a high level but persisted longer than in any other material. It began in June, with an average of 16.4 flies per culture, and continued at about the same level during July and August, after which the number decreased gradually until breeding stopped in November. The number of *Musca vicina* bred from solid feces and pig manure varied greatly from month to month. Breeding in solid feces began in June with an average of 80.3 flies per culture. From this peak the number dropped to a low level in July and August, and finally ceased in September. Breeding in pig manure

TABLE 4.—*Showing the monthly variations in the average number of the four groups and different species of flies bred per culture from different media during April to November, 1936.*

	April	May	June	July	August	September	October
A.—*Musca vicina*							
Pig manure	0.0	0.0	0.0	14.9	420.7	18.9	0.0
Solid feces	0.0	0.0	80.3	7.2	7.5	0.0	0.0
Liquid feces	0.0	0.0	7.7	3.7	0.0	0.0	0.0
Horse manure	0.0	0.0	16.4	13.2	13.6	5.4	3.1
Cow manure	0.0	0.0	0.0	1.2	0.3	0.0	0.6
Soil compost	0.0	0.0	0.0	1.2	0.3	0.0	0.0
Average	0.0	0.0	17.4	6.9	73.7	4.9	0.6
B.—*Chrysomyia megacephala*							
Liquid feces	0.0	0.0	0.0	14.5	68.9	103.6	0.0
Solid feces	0.0	0.0	0.0	0.0	7.5	19.2	0.0
Pig manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horse manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cow manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Soil compost	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	2.4	12.7	20.5	0.0
C.—*Other Species Group I*							
Pig manure	0.0	0.0	114.3	2.3	8.8	0.3	0.0
Solid feces	13.5	55.2	75.0	14.0	12.2	27.5	0.2
Liquid feces	0.3	0.5	35.3	7.7	14.8	1.2	0.0
Horse manure	0.0	0.0	0.1	0.0	0.0	0.6	0.0
Cow manure	0.0	0.3	0.0	0.0	0.2	0.3	0.0
Soil compost	0.0	0.5	0.0	0.7	0.0	0.2	0.0
Average	2.3	10.5	37.5	4.1	6.0	5.0	0.1
D.—*Other Species Group II*							
Pig manure	48.8	225.9	7.6	0.0	68.2	102.0	38.0
Solid feces	112.5	145.8	8.0	5.8	44.7	3.0	2.0
Liquid feces	0.0	0.0	1.7	0.7	0.7	0.6	0.0
Horse manure	0.0	0.6	0.0	1.3	0.4	2.1	0.4
Cow manure	0.0	43.3	72.8	7.3	81.6	11.5	2.5
Soil compost	0.0	0.0	3.7	2.2	0.7	0.2	0.3
Average	26.9	69.3	15.6	2.9	32.7	19.9	7.2

TABLE 4.—*Showing the monthly variations in the average number of the four groups and different species of flies bred per culture from different media during April to November, 1936—(Continued.)*

E.—*Sarcophaga*

	April	May	June	July	August	September	October
Pig manure	0.0	6.0	114.3	2.3	8.8	0.1	0.0
Solid feces	0.5	35.3	68.0	14.0	12.2	27.5	0.2
Liquid feces	0.3	0.5	35.3	7.7	14.8	0.9	0.0
Horse manure	0.0	0.0	0.1	0.0	0.0	0.3	0.0
Cow manure	0.0	0.1	0.0	0.0	0.2	0.0	0.0
Soil compost	0.0	0.0	0.0	0.7	0.0	0.0	0.0
Average	0.1	7.0	36.3	4.1	6.0	4.8	0.1

F.—*Muscina stabulans*

	April	May	June	July	August	September	October
Solid feces	13.0	19.8	7.0	0.0	0.0	0.0	0.0
Cow manure	0.0	0.7	0.0	0.0	0.0	0.0	0.0
Soil compost	0.0	0.5	0.0	0.0	0.0	0.0	0.0
Pig manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liquid feces	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horse manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	2.2	3.5	1.2	0.0	0.0	0.0	0.0

G.—*Lucilia sericata*

	April	May	June	July	August	September	October
Pig manure	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Liquid feces	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Horse manure	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Cow manure	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Soil compost	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Solid feces	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.2	0.0

H.—*Musca tempestiva*

	April	May	June	July	August	September	October
Cow manure	0.0	17.5	66.2	0.5	48.4	2.4	0.0
Pig manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solid feces	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liquid feces	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horse manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Soil compost	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	2.9	11.0	0.1	8.1	0.4	0.0

I.—*Musca hervei*

	April	May	June	July	August	September	October
Cow manure	0.0	0.0	5.3	4.9	24.7	5.3	1.2
Soil compost	0.0	0.0	0.0	0.0	0.5	0.2	0.0
Pig manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solid feces	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liquid feces	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horse manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.9	0.8	4.2	0.9	0.2

TABLE 4.—*Showing the monthly variations in the average number of the four groups and different species of flies bred per culture from different media during April to November, 1936*—(*Continued.*)

J.—*Stomoxys calcitrans*

	April	May	June	July	August	September	October
Pig manure	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Solid feces	0.0	0.0	0.0	1.0	10.5	0.3	0.0
Horse manure	0.0	0.0	0.0	1.3	0.4	2.0	0.1
Cow manure	0.0	0.0	0.2	0.2	0.2	0.0	0.0
Soil compost	0.0	0.0	3.0	0.0	0.0	0.0	0.0
Liquid feces	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.6	0.7	1.9	0.4	0.1

K.—*Stomoxys exigua*

	April	May	June	July	August	September	October
Cow manure	0.0	3.8	0.9	1.4	1.8	0.1	0.8
Pig manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solid feces	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liquid feces	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horse manure	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Soil compost	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.6	0.2	0.2	0.3	0.01	0.1

L.—*Miscellaneous species*

	April	May	June	July	August	September	October
Pig manure	48.8	225.9	7.2	0.0	68.2	102.0	38.0
Solid feces	112.5	145.8	8.0	4.8	84.2	2.7	2.0
Liquid feces	0.0	0.0	1.7	0.7	0.7	0.6	0.0
Horse manure	0.0	0.6	0.0	0.0	0.0	0.1	0.3
Cow manure	0.0	21.9	0.3	0.3	6.6	3.7	0.6
Soil compost	0.0	0.0	0.7	0.7	0.2	0.0	0.3
Average	26.9	65.7	3.0	1.1	18.3	18.2	6.9

started late with 14.9 flies per culture for July but reached the highest number (240.7) for any medium in August, after which the number dropped rapidly in September and finally stopped in October. Breeding in liquid feces followed the same trend as it did in solid feces but with a much lower peak in June and stopped a month earlier in August. When the breeding of *Musca vicina* in all media is considered for the whole breeding season, the most striking fact is that there was a definite shift from heavy breeding in solid feces early in the season to heavy breeding in pig manure in late summer. This shift results in the curve for the average of all media showing two peaks, a low one in June and a higher one in August with a distinct decline for the month of July in between.

The prevalence of *Musca vicina* as shown by the fly density index in paper *B* of this subseries (Meng and Winfield, 1941a) can be explained by these breeding data. Fig. 1 in paper *B* shows that in the indoor stations, *Musca vicina* was fairly abundant in June but reached its peak in July. From this July peak there was a steady decline in number through August to September. This species persisted through October and November and disappeared in December. The July density peak in the rooms is undoubtedly due to the June breeding in solid feces. The density peak is delayed due to the interference resulting from the flies in making their way into houses. The fact that there was little pig manure exposed in the community during the period when breeding was at its peak in this medium explains why it did not produce a second density peak in the indoor stations. The October density peaks shown by stations 1 and 5, however, very likely were influenced by breeding in pig manure. When the densities in outdoor stations as shown in Fig. 3 of paper *B* are considered,

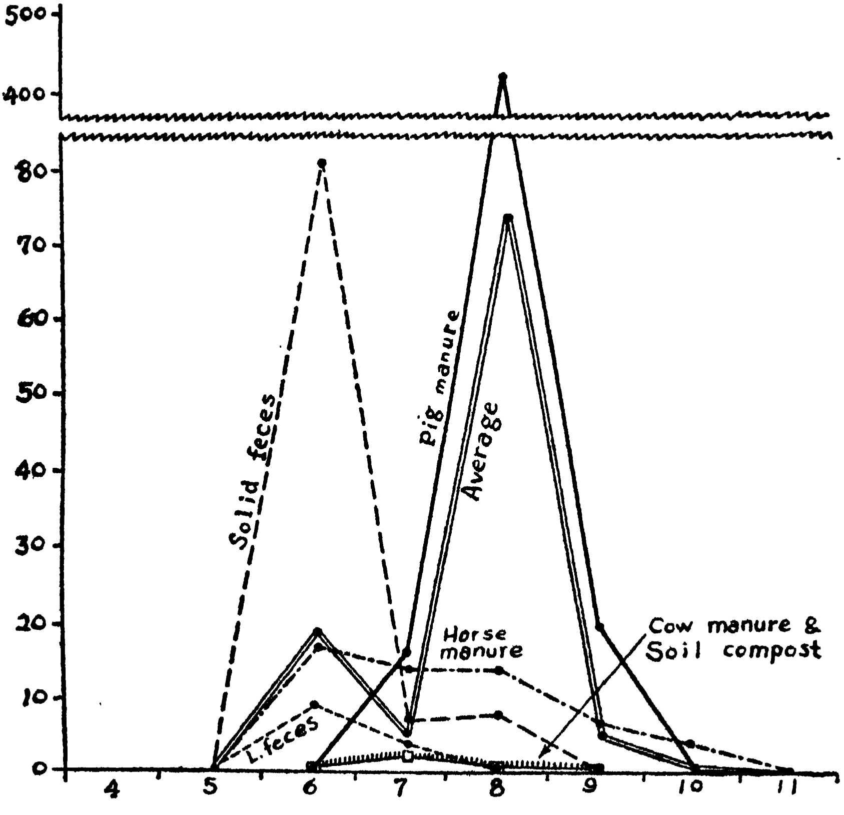

FIG. 1.

the August peak in density corresponds to the August peak of breeding in pig manure. In a number of outdoor stations breeding in pig manure undoubtedly played a considerable part in building up the *Musca vicina* population.

Chrysomyia megacephala.—(Table 4 B) The breeding of this species is striking in its relation to media and climatic factors. It was found breeding in only three types of media, two of which were followed throughout the season. No breeding occurred in any medium before July. In that month breeding started in liquid feces, the intensity increasing steadily during August and finally reached a peak in September. Breeding in solid feces followed the same trend as in liquid feces but began a month later and showed a much lower peak in September. Liquid feces was by far the most important of the two media.

The correlation between breeding and density in the outdoor stations as shown in paper *B* is striking and further emphasizes the climatic adaptation which this species exhibits. Fig. 3 in paper *B* shows that *Chrysomyia megacephala* was taken in the traps only in very small numbers during June and July. This correlates with the fact that it was not found breeding till July when it began to breed in increasing numbers in liquid feces. These in turn is correlated with the fact that before July, climate in Tsinan is very dry, even though the temperature may be just about as high in June as it is in July. Since *Chrysomyia megacephala* prefers to breed in liquid feces and since it seems that the adults need both a high temperature and a high humidity to sustain their activity, fast breeding begins only after the rainy season starts in July. The arrival of the rainy season affects this species through the creation of numerous breeding places as a result of flooding latrine pits and also by providing a high humidity which the adults need. This results in a sudden rise in the number of individuals coupled with a great increase in the rate of breeding so that both the breeding and density curves mount rapidly to a peak in September. The end of this month marks the end of breeding and in October the numbers of flies in outdoor stations drop drastically. After breeding ceases the adults do not persist any longer so that they all disappeared by the end of October.

Other Species Group I.—The numbers of flies bred per culture per month for the whole group are shown in Table 4 C and the numbers found breeding in each type of medium are graphed in Fig. 2. Breeding of the whole group took place

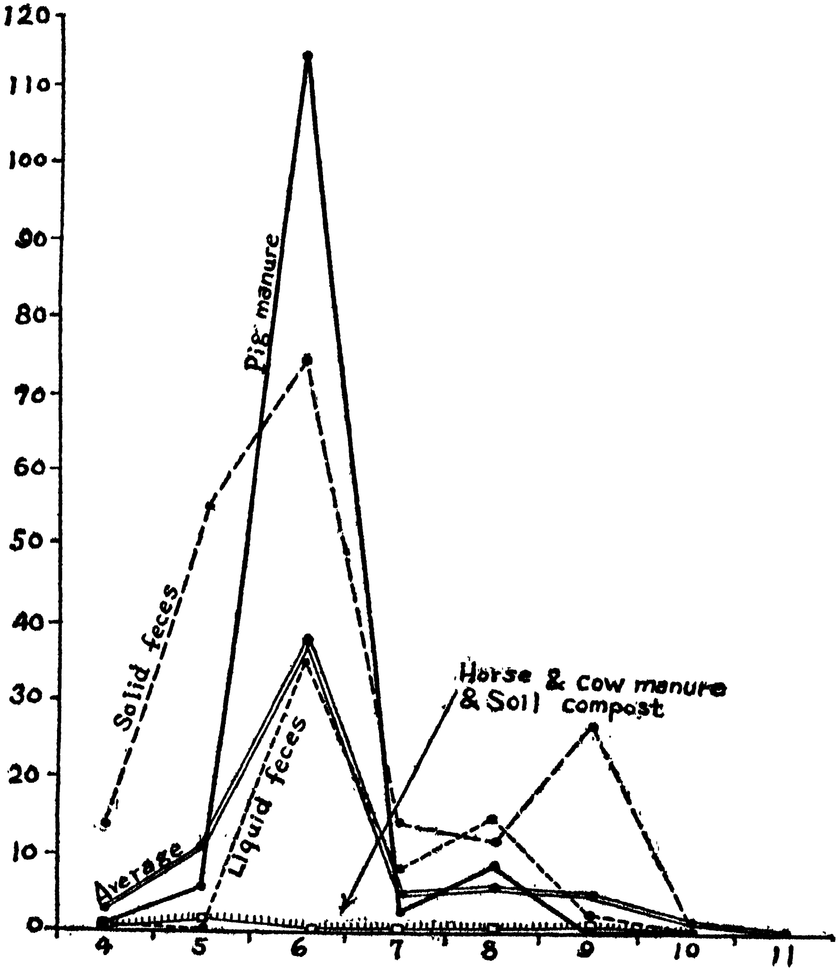

FIG. 2.

from April to October. Breeding in cow manure, horse manure and soil compost was so slight as to be unimportant. Solid feces produced the largest number of flies in any medium in five out of the seven months of the fly season. There was a steady increase of number of flies during April and May reaching a high peak in June, after which breeding dropped rapidly in July and August. Again it increased to a low peak in September and then dropped through October to cease entirely in November. In liquid feces breeding occurred during April to September with a high peak in June, a decline in July, and a lower peak in August. Breeding in pig manure varied greatly during the different months. In this medium breeding began with 6 flies per culture in May then rises to a peak with the largest number (114.3) per culture for any medium in June. This June peak is separated from a low August peak by a decline in July. Breeding was slow in September and ceased in October. The curve for the average of all media shows a distinct peak in June.

The breeding of the individual species of this group is shown in Table 4 E, F, and G. The table shows that *Lucila sericata* bred only during September. *Muscina stabulans,* an early spring breeder, was found breeding from April to June with a peak in May. Both these species were found in rather small numbers in the cultures. On the other hand, *Sarcophaga* was the most abundant species of the group during six out of seven months of the fly season. It was found breeding during April to October. The number bred per culture increased rapidly during April and May and reached a peak of 36.6 flies in June, after which the number dropped to an average of 4.1 in July and continued at about this level during the next two months. Breeding stopped in November.

It is impossible to explain the density of *Lucila sericata* in the fly population on the basis of these fecal cultures. The most suitable and very likely the most important breeding medium for this species in Tsinan, as well as in other parts of China, is decaying animal tissue which was not included in our mass culture series (see Table 1 column 8 for the percentage of flies bred from decaying beef used as bait in certain experiments, which belonged to this species).

As shown in Fig. 5 of paper *B*. *Muscina stabulans* occurred in outdoor stations from April to November, with a first peak in May and a second one in October with a decline in August. The first part of this density graph corresponds well with the breeding data (Table 4 F) but the second part of it is difficult to explain. Perhaps the October density peak for this species was due to breeding in some medium such as city garbage which was not followed by mass cultures during the whole season.

Fig. 5 of paper *B* shows that *Sarcophaga* was present in the outdoor stations during April to November with a first lower peak in June separated from a second higher one in September by a downward trend in July. The first part of this graph corresponds well with that showing the breeding of this genus, while the second part with its September peak can not be explained by this breeding data. In this case, however, we are dealing with a whole genus and one in which a large number of species are known to prefer decaying flesh as a breeding medium. It seems likely, therefore, that the September density peak was due to the species which breed in decaying flesh, while the species making the June peak bred in pig manure, solid and liquid feces.

Other Species Group II.—The breeding of this group in different media is shown in Table 4 D and Fig. 3. The table shows that breeding occurred during April to October. In liquid feces, horse manure and soil compost breeding was very slight. Fig. 3 indicates that breeding in solid feces occurred from April to October with a high peak in May separated from

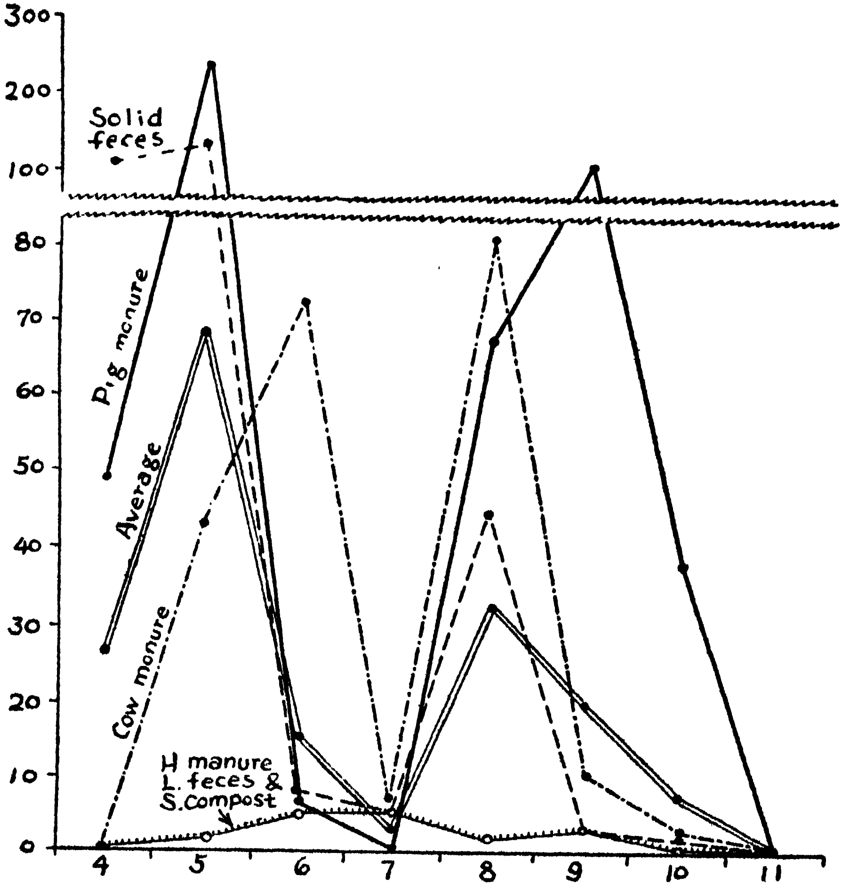

FIG. 3.

a low peak in August by a decline in June and July. Breeding in pig manure was found during April to October, with a high peak in May and a low peak in September separated by a decline in July. Breeding in cow manure occurred during May to October with peaks in June and August separated by a decline in July.

Breeding of the individual species of this group in each and in all types of media combined is shown in Table 4 H, I, J, K, and L. *Musca hervei* bred during June to October with a peak in August. *Musca tempestiva* bred from May to September with peaks in June and August separated by a decline in July. *Stomoxys calcitrans* bred during June to October with a peak in August. *Stomoxys exigua* bred during May to October in small numbers. All the other species of this group combined bred during April to October with a high peak in May, a decline in July and a low peak in August.

The adults of this group of flies occurred in the outdoor fly trapping stations during April to November, as shown in Fig. 5 of paper *B* where the group is called the *Miscellaneous Species Group*. There was a low density peak in June separated from a somewhat higher peak in September by a decline in July. The breeding of this group corresponds with the density curve except that the breeding peaks occur a month in advance of the density peaks. Both breeding and density data show the same decline in July.

The way in which quantitative information about the time and amount of breeding of the various species and groups of flies making up the Tsinan fly population fit and explain quantitative information about the density of those species and groups is highly significant. It hardly seems probable that one set of data could so fully fit and explain the other if the methods by which both sets of data were gathered were seriously unreliable. It seems justifiable, therefore, to conclude that the quantitative methods being presented in this series of papers are reasonably reliable.

The July fly population crisis.—The density and breeding shown in the preceding sections bring to light a very peculiar and interesting feature of the fly population of Tsinan. This feature consists in the fact that in every group of flies both the number of adults present in the population and the rate of breeding show very distinct dropping off during the month of July. It has already been pointed out that in several groups there is a shift from one type of breeding medium which occurs at this point in time. It has been pointed out that *Chrysomyia megacephala* makes its appearance and becomes the dominant species in the outdoor stations only after July. The consistency with which both the number of adults and the number of flies breeding drop during July indicates that in that month some sort of a crisis occurs which results in radical change in the make up of the population and the nature of its breeding activity. The underlying cause of this crisis has already been indicated in discussing the breeding of *Chrysomyia megacephala.* It is the arrival in July of the rainy season. Reference to the temperature and rainfall graph for Tsinan which was published in an earlier number of this series of papers (Windfield, 1937) shows that the mean daily temperature in June is only slightly below that of July and about equal to that of August. On the other hand the mean rainfall in July is more than twice as great as that in June but only slightly greater than that of August. This sudden change from a hot dry climate in May and June to a hot humid climate in July is responsible for the crisis which occurs in the fly population in July. All species and groups are forced to adjust themselves to radical new conditions at this time so that both breeding and population density drop off. For example *Musca vicina* which breeds much more actively in solid than in liquid feces has available large amounts of solid feces during the hot dry season. When rainy season arrives it suddenly finds that most of its solid feces breeding places have been changed into liquid feces in which it breeds only with difficulty. It, therefore, shifts its breeding to pig manure, which during the dry period was too dry for optimum breeding but which became more suitable after the arrival of the wet season. The way in which this crisis affects the different species and groups has already been shown and need not be discussed again in detail. However, emphasis should be made regarding the consistency with which it occurs in all groups, and that each group of flies has made its own peculiar adjustment to this rather sudden and radical change in the environmental conditions which takes place with the arrival of the heavy rains in July. It is not possible to state whether this crisis is a yearly occurrence or only takes place in years with exceptional dry spring weather.

D. SEX RATIO OF FLIES BRED FROM MASS CULTURES

The sex ratios of the important species of flies breeding under natural conditions in Tsinan during the summer of 1936 as indicated by the average number of female or females to each male which were produced in the mass cultures were as follows: *Musca vicina* (0.94), *Chrysomyia megacephala* (1.02), *Sarcophaga* (1.01), *Muscina stabulans* (0.96), *Musca hervei* (1.07), *Lucilia seriata* (0.86), and *Musca tempestiva* (0.87). Thus with the exception of the two latter species in which more males than females were produced, the numbers of the two sexes of any of the other species produced were approximately equal.

2. *Examination of rural latrines.*—It has already been pointed out that the pen-latrine is the most common method of storing all types of organic wastes for the production of fertilizers in the form of soil compost in the Shantung villages. In the series of mass cultures reported on above, soil composts from pen-latrines in the villages of the Tsinan City area were included. As a part of the study of the rural fly population in the Lungshan area (Meng and Winfield, 1942) all the public and pen-latrines of Hu Chung P'o, one of the villages studied, were surveyed for fly breeding on August 19 and 20, 1947. There were in the entire village 53 pen-latrines and two public latrines. Half gallon samples were taken from each latrine and the numbers of larvæ and pupæ were counted and identified. The already difficult task of getting a representative sample from the pen-latrines was further increased because they were flooded from recent rains. The results of the examination are shown in Table 5. Flies were found breeding in 63.9 per cent of the latrines and 18.9 per cent of them were producing flies of public health importance. Of the total number of flies found only 10 per cent belonged to species of public health importance.

The extremely small numbers of flies found confirm the results obtained with soil compost in the mass cultures reported above and help to explain why the general fly density index as well as the density indices of *Musca vicina, Chrysomyia megacephala, Muscina stabulans,* and genus *Sarcophaga* for the rural area at Lungshan was much lower than that for the urban area at Tsinan (Meng and Winfield, 1942). This is to be expected since in the urban area there were more opportunities for the flies to breed due to the comparatively larger amounts of feces in latrines and feces cake drying grounds, of pig manure in sties and abattoirs, of horse manure in piles and stables, and of garbage in dumps. That the density indices of *Luscilia sericata* in both areas were much alike (Meng and

Windfield) was not to be expected when breeding habits and opportunities are concerned since animal garbage, the most suitable medium for this species, should be more abundant in the urban than in the rural area. Here other factors, such as dispersion of the fly by flight, might be at work which help to keep its density at the same level in both areas. That the *Miscellaneous Species* was more abundant in the rural than in the urban area (Meng and Winfield) may possibly indicate that unmixed pig manure, solid feces, and cow manure might often present on the surface of the compost in the pen-latrines in such a proportion and amounts so that they produced less flies of the important species and more individuals of the miscellaneous flies in the rural than in the urban area.

Sarcophaga was the only genus of public health importance which was found breeding in the two public latrines at the time of this examination. As these pit latrines were the only places in the village where liquid feces were present in large quantities, it is likely that they were also important in producing *Chrysomyia megacephala* which is common in the village.

3. *Laboratory experiments on the suitability of four types of media for breeding Musca vicina.*—Ten experiments done between August 27 and September 4, 1937 were designed to determine the relative suitability for breeding *Musca vicina* of four types of fecal material. The method used was to expose equal quantities of the four media at the same time to a number of adult *Musca vicina* in a large cage and then to determine the number of third larvæ and pupæ produced per culture. The average number of flies produced per culture and its standard error for the different media were as follows: pig manure (418.4∓90.2), solid feces (240.2∓59), horse manure (68∓1.3), and cow manure (1.1∓0.1).

Since more than 6,000 third larvæ and pupæ were recovered from the 40 cultures it is evident that the conditions for oviposition within the breeding cage were suitable for *Musca vicina*. Almost two thirds of all the flies found were in the pig manure with the ten cultures averaging 418.4 per culture. However, the standard errors in this series of experiments were quite large, because the number and age of the adult flies used varied from experiment to experiment with the result that while the mean number found per culture of solid feces was only 240.2 still it was not significantly different from the number breeding in pig manure. The suitability of pig manure for breeding this species was significantly greater than either horse manure or cow manure as was solid feces also. This experiment shows quite conclusively that both pig manure and solid feces are better breeding media for *Musca vicina* than is horse manure. There is also a strong presumption that pig manure is better than solid feces for a slightly longer series of experiments would almost certainly have shown a significant difference between these two media. In the light of the results shown by the mass cultures it is almost certain that pig manure is the material which is most attractive to the egg laying females and is most suitable for producing this spicies of flies in the Tsinan Area.

TABLE 5.—*Showing the results of examinations of 53 pen-latrines in Hu Chung P'o from August 19 to 20, 1937*

	Positive latrines		Larvae and pupae recovered		
	Number	Per cent	Number	Per cent	Average number per sample
Flies of health importance—					
Musca vicina	4	7,6	4	0.9	0.08
Chrysomyia megacephala	1	1.9	1	0.2	0.02
Sarcophaga	9	17.0	38	8.9	0.71
Total	10	18.9	43	10.0	0.81
Stomoxys calcitrans	4	7.6	9	2.1	0.17
Eristalis sp.	11	20.8	49	11.5	0.92
Musca hervei	1	1.9	1	0.2	0.02
Fannia canicularis	1	1.9	4	0.9	0.08
Unidentified species	24	45.1	323	75.3	6.09
All flies	34	63.9	429	100.00	8.09

IV. SUMMARY

The breeding habits of the West Shantung fly population were studied extensively during 1936 and 1937 by making, according to a definite time schedule, a large number of standard mass cultures of different media from 19 stations in and around Tsinan (Urban Area); by making examinations of 53 pen-latrines and 2 public latrines in a village in the Lungshan Rural Area; and by making a series of 10 laboratory breeding experiments on the suitability of four types of media for the breeding of *Musca vicina.* These data indicated the following results:

1. The important findings obtained with the mass cultures are:

A. *Musca vicina* was found breeding in all types of media except decaying beef. Pig manure, the most suitable medium for this species, was more than 3 times as suitable as either solid feces or garbage and approximately 6, 40, 160, and 220 times as suitable as horse manure, liquid feces, cow manure, and soil compost respectively. This species was found breeding during June to October with a low peak in June separated by a decline in July from a higher one in August due to shift of breeding from solid feces to pig manure.

B. *Chrysomyia megacephala* was found breeding in liquid and solid feces, garbage, and decaying beef. Cultures of beef were not standardized. Liquid feces, the most suitable medium, was more than 3 and 9 times as suitable as garbage and solid feces respectively. It bred in feces cultures during July to September with the peak of greatest intensity in the latter month.

C. Genus *Sacrophaga* bred in all types of media cultured. Solid feces was found to be 1.2, 3.5, and 24.5 times as suitable as pig manure, liquid feces, and city garbage respectively and approximately 270 times as suitable as horse or cow manure or soil compost in producing this genus. It was bred during April to October with the highest point reached in June.

D. *Lucilia sericata* bred in large numbers in decaying beef and to some extent in other materials except solid feces. It bred only during September in fecal cultures.

E. *Muscina stabulans* bred in solid feces, city garbage, cow manure, and soil compost. The former material was over 50 times as suitable as each of the three latter media in breeding this species. It bred during April to June with the highest peak in May.

F. There was found close correlation between the monthly variations in the number of flies bred per culture of different media and the density indices of these flies in different trapping stations of the same area. This fact shows that the mass cultures and fly trapping methods used in these studies are reliable means of investigating fly breeding and fly density respectively.

2. Examination of pen-latrines showed that soil compost is relatively unsuitable for breeding all flies. This correlates with the fact that *Musca vicina, Chrysomyia megacephala, Muscina*

stabulans, and genus *Sarcophaga* were more dense in the urban than in the rural area in West Shangtung since in the rural area soil compost was the only abundant breeding material while in the urban area both human and animal fecal materials and city garbage were abundant.

3. Laboratory breeding experiments with *Musca vicina* showed that pig manure was 1.7 times as suitable as solid feces and approximately 72 and 380 times as suitable as horse and cow manure respectively in breeding this species, although the difference between the first two was not statistically significant.

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ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Showing monthly variations in the average number of *Musca vicina* bred per culture of different types of media during 1936 in Tsinan. Ordinate: number of flies; abscissa: months.

2. Showing monthly variations in the average number of *Other Species Group I* bred per culture of different types of media during 1936 in Tsinan. Ordinate: number of flies; abscissa: months.

3. Showing monthly variations in the average number of the *Other Species Group II* bred per culture of different types of media during 1936 in Tsinan. Ordinate: number of flies; abscissa: months.

LONGICORN BEETLES FROM THE RYUKYU ISLANDS (COLEOPTERA: CERAMBYCIDÆ)

By J. LINSLEY GRESSITT
Of the Lingnan Natural History Survey and Museum
Lingnan University, Canton, China

FIVE TEXT FIGURES

This paper is an attempt to bring together the available information on the Cerambycidæ from the Ryukyu Archipelago, at the same time adding a few new records and five new species. The material reported upon is largely in the California Academy of Sciences (C. A. S.) in San Francisco, and was collected by the writer in 1932, 1934, and 1945, as well as by Mr. H. Yashiro from 1918 to 1934, by Dr. J. C. Thompson in 1911, and by Drs. R. M. and G. E. Bohart in 1945. Other material studied is in the Taiwan Agriculture Research Institute (Tai. Agr. Res. I.) in Taipeh, Formosa and still further specimens were collected by Y. Maki, J. E. A. Lewis, and others. I am indebted to Prof. T. C. Maa (Maa Tsing-chao), Mr. T. Mitono, Mr. H. Yashiro, Mr. Y. Maki, Dr. Y. Miwa, Dr. E. S. Ross and Mr. Hugh B. Leech for their cooperation.

The Ryukyu (Loochoo, Riukiu, Liukiu, Luchu, or Nansei) Archipelago stretches from the southern limits of Japan, southwest to a point some distance off the east coast of north central Formosa (lat. 24° to 29°N.). It represents a considerably submerged portion of the largely volcanic chain of islands fringing the continental shelf of Asia. The fauna of the Ryukyus is considerably impoverished, compared with Japan and Formosa. It seems to represent the northernmost insular extension of the Oriental region, though to some extent it displays an intergradation of the Palæarctic and Oriental faunæ, the latter also definitely asserting itself in Japan. Thus, a distinct line of absolute demarkation separating the two zoögeographical regions between the Ryukyu chain and Japan can not be made. If the mountains in the Ryukyus were higher (none are as high as one thousand meters), more Palæarctic species might be expected to exist there, as many Palæarctic genera are found in the high mountains of Formosa.

Species from Tanegashima and Yakushima, just south of Kyushu, are not included, since these islands are zoögeographically more allied with Kyushu than with the Ryukyu Islands and are to the north of Watase's Line, which is often considered the arbitrary boundary between the Palæartic and Oriental Regions. Fifteen Palæartic species not found in the rest of the archipelago occur on these two islands (see Appendix, II–III).

The species listed herein number 89, of which 42 are known from Amami-Oshima, seven from Tokunoshima, 47 from Okinawa (besides four listed merely from Ryukyu), eight from Miyako, 29 from Ishigaki (Yaeyama), and 33 from Iriomote. Amami-Oshima ("Harbour I.") and Tokunoshima represent the Amami Group in the north, Okinawa ("Greater Loochoo") and its islets (Kume, Ie, etc.) the Central Group, and Miyako (Typinsan), Ishigaki (Patchusan) and Iriomote ("Racho o ko ko") the Sakishima ("Madjicosemah") Group in the south, with the last two, Ishigaki and Iriomote, forming the Yaeyama subgroup. Four species are known from Yonakuni, between the latter and Formosa. Of the 47 genera represented herein, seven are considered to be Holarctic, 36 Oriental and four cosmopolitan or pan-Asian. Of the 26 endemic species, one is thought to be Palæarctic and 25 Oriental in their relationships and of the 63 non-endemic species, ten Palæarctic, 52 Oriental and one American (questionable record) in their relationships. Of these 63 non-endemic species, 31 are found also in Japan, and of these 14 in Japan and Korea, eight in Japan and N. China (seven of them in Korea), and one extends as far as Siberia and Europe. On the other hand, 43 occur in Formosa, and of these 12 in Formosa and South China, three in Formosa and Botel-Tobago (two of which are included among three in Formosa and the Philippines), and four are widely distributed in southern Asia and the East Indies. One species is found in Hainan but not in Formosa. Sixteen of the species occur both in Japan and Formosa; a total of 19 is found in China.

There is no such conspicuous example of the Philippine element in the Ryukyu fauna of this family as there is among the weevils with *Pachyrrhynchus infernalis* Fairmaire of the southern Ryukyus. That species represents the predominantly Philippine tribe Pachyrrhynchini which has several representatives on Botel-Tobago Island (Kotosho) east of southern Formosa. The genus *Abryna,* however, is largely composed of Philippine species, though also occuring on Formosa and the mainland of southern Asia, as is not the case with *Pachyrrhyn-*

chus. The genus *Ceresium,* so widely distributed among the Pacific islands, is also well represented in the Ryukyus. It, also, is found on the mainland of southern Asia.

The references and synonymy are not complete for the non-endemic species. In most cases only the references to the original description and the more important Ryukyu records are included, sometimes with the addition of a reference to an illustration. As a rule, synonyms applied in other geographical areas and citations to the various generic combinations are not included. Most of the host plants listed are not original in the present paper and have not been verified for the Ryukyu Islands, but have been associated with the same species in Japan, Formosa or China.

Unfortunately some of the past records for the archipelago are confusing, principally because of the general unfamiliarity of some workers with the geography of the islands. Sometimes in a single work, or under the same species, an author has referred to Okinawa and Ryukyu as separate individual islands or groups. Also, since specimen-labels for the chain of islands often also bear Japan, some records have been misinterpreted or names have been applied as referring to Japan itself. Four valid species have been recorded from the archipelago without any particular island being specified.

Synopsis of the Ryukyu Cerambycidæ

1. Antennæ inserted fairly close to bases of mandibles 2

   Antennæ not inserted fairly close to bases of mandibles 5

2. (1). Prothorax margined laterally, often with teeth along margin; anterior coxæ strongly transverse (subfamily Prioninæ) 3

   Prothorax not margined laterally; anterior and middle tibiæ not grooved preapically; antennæ short and stout (subfamily Aseminæ; black; rather stout, with short stout legs . . . . *Spondylis buprestoides*

3 (2). Body not very flat, not parallel-sided; antennæ rough, tapering (*Megopis*) 4

   Body rather flat and smoothish above; antennæ not very rough and not strongly tapering; prothorax squarish (Eurypodini); dark reddish brown .... *Eurypoda* (*Neoprion*) *batesi*

4 (3). Prothorax not very strongly convex, trapeziform; antennæ moderately tuberculate; length rarely over 50 mm. ....*Megopis* (*Aegosma*) *sinica*

   Prothorax strongly convex, rounded at sides; antennæ very strongly tuberculate; length 65 mm. *Megopis* (*Aegosma*) *validicornis*

5 (1). Head generally elongate and strongly constricted behind eyes; anterior coxæ conical and prominent; mandibles often with a ligamentous fringe (subfamily Lepturinæ) 6

   Head generally not elongate and not strongly constricted behind eyes; anterior coxæ not conical and prominent; mandibles not fringed 9

6 (5). Abdomen not conspicuously narrower than metathorax in male; prothorax broad basally and somewhat produced over humeri (*Leptura*) 7

Abdomen conspicuously narrower than metathorax in male, cylindrical; prothorax not very broad or produced basally (*Strangalia*) 8

7 (6). Undersides of first two hind tarsal segments without a smooth median groove; dorsal surfaces transversely banded with black and yellow; body fairly broad *Leptura* (s. str.) *auratopilosa*

Undersides of first two hind tarsal segments with a smooth median groove; dorsal surfaces bright red; body rather narrow .... *Leptura* (*Pedostrangalia*) *coccinea*

8 (6). Pronotum ochraceous with two free black lines on disc; elytra banded with black and ochraceous; antennæ yellow with apices black .... *Strangalia* (s. str.) *gracilis*

Pronotum black; elytra brownish with a black spot on side of each near middle; antennæ black with eighth to tenth segments pale .... *Strangalia* (s. str.) *longicorne*

9 (5). Anterior and middle tibiæ not obliquely grooved preapically; head more or less obliquely inclined anteriorly; apical palpal segments blunt (subfamily Cerambycinae) 10

Anterior tibiæ obliquely grooved internally and middle tibiæ obliquely grooved externally; head more or less vertical in front with mouth directed somewhat backward beneath; apical palpal segments acute (subfamily Lamiinæ) 41

10 (9). Eyes coarsely facetted, except in certain Obriini (small slender species) 11

Eyes finely facetted 26

11 (10). Middle coxal cavities open externally to epimera 12

Middle coxal cavities closed externally, not open to epimera.... 14

12 (11). Intercoxal process of prosternum very narrow, not broadened distally 13

Intercoxal process of prosternum wide, broadened distally (Cerrambycini); fairly slender, parallel-sided; prothorax as broad as long, its disc with very fine irregularities; pale buff; length 20 mm. .... *Margites fulvidus*

13 (12). Maxiliary palpi distinctly longer than labial palpi; ligula corneous; prothorax not tuberculate laterally (Achrysonini); pronotum with three longitudinal raised lines, median one complete, lateral ones incomplete, broad and curved; reddish brown; length 14 to 25 mm. .... *Nortia carinicollis*

Maxillary palpi hardly longer than labial palpi; ligula membranous; prothorax sometimes tuberculate laterally (Hesperophanini); prothorax somewhat rounded laterally, hairy; elytra roughened by granules and punctures; dark brown; length 18 to 28 mm. .... *Stromatium longicorne*

14 (11). Some of basal antennal segments spined distally (Phoracanthini) 15

Antennal segments not spined 16

15 (14). Antennæ of male twice as long as body; antennal insertions strongly swollen; hind femora slightly exceeding elytral apices .... *Allotræus (Nysina) asiaticus*

Antennæ of male one one-half times as long as body; antennal insertions feebly swollen; hind femora not quite reaching elytral apices .... *Allotræus (Nysina) insularis*

16 (14). First abdominal segment, normal, not greatly enlarged; eyes large and very coarsely facetted (Callidiopini) 17

First abdominal segment nearly, or fully, as long as remaining segments combined; second and following segments greatly reduced in female; eyes sometimes large, but sometimes finely facetted (Obriini) 24

17 (16). Tibiæ not curved, not carinate on outer margins 18

Tibiæ curved, carinate on outer margins; body smooth and shiny; chestnut brown, darker, but with four pale spots, on anterior three-fifths of elytra; length 7 to 13 mm. .... *Stenygrinum quadrinotatum*

18 (17). Prothorax cylindrical or rounded at sides; femora clavate (*Ceresium*) 19

Prothorax trapeziform, strongly narrowed anteriorly; femora slender; dark brown, rather densely pubescent .... *Neosalpinia lepturoides*

19 (18). Third antennal segment longer than fourth 20

Third antennal segment as long as fourth; elytra evenly punctured throughout reddish testaceous; length 9 mm. .... *Ceresium holophæum*

20 (19). Scape longer than third antennal segment 21

Scape no longer than third antennal segment 22

21 (20). Sides of prothorax not densely clothed with pubescence; pitchy to dark reddish brown; scutellum densely pubsecent; length 9 to 14 mm. .... *Ceresium fuscum*

Sides of pronotum densely clothed with pale pubescence; reddish brown; length 11 to 15 mm. .... *Ceresium sinicum*

22 (20). Scape shorter than third antennal segment 23

Scape as long as third antennal segment; sides of pronotal disc with spots of dense pale tawny pubescence; prothorax broad; reddish brown, femora paler; length 12 to 15 mm. .... *Ceresium flavipes*

23 (22). Prothorax slightly longer than broad; antennæ of male one-half again as long as body; length 8 to 10 mm. *Ceresium longicorne*

Prothorax nearly twice as long as breadth at base; antennæ of male less than one-fourth again as long as body; length 11 mm. .... *Ceresium elongatum*

24 (16). Prothorax not bluntly tuberculate at sides, more or less rounded, or narrowed basally; antennæ without very conspicuous hairs at ends of basal segments 25

Prothorax bluntly tuberculate at sides; basal antennal segments with conspicuous long hairs particularly at apices, prothorax broader at apex than at base, with lateral tubercles at middle; pale castaneous with oblique testaceous marks on elytra; length 7 mm. .... *Stenhomalus cleroides*

25 (24). Eyes large, coarsely facetted; elytra broadened behind middle; pale castaneous; elytra with incomplete bands composed mostly of spots; length 4 to 5 mm. .... *Iphrobrium dilatipenne*

Eyes not very large, finely facetted; elytra nearly parallel-sided; reddish brown, dusky on posterior portions of elytra; length 4.7 mm. .... *Pseudiphra obscura*

26 (10). Anterior coxal cavities open behind, or if closed, then scent-pores present at behind angles of metasternum; elytra not abbreviated 27

Anterior coxal cavities closed behind; scent-pores absent; elytra short (Molorchini); prothorax densely punctate, feebly tuberculate laterally; length 8 to 9 mm. .... *Molorchus* (*Linomius*) *takeuchii*

27 (10). Scutellum not both large and acute posteriorly, metasternum without scent-pores at posterior angles; anterior coxal cavities open posteriorly 28

Scutellum large and acute posteriorly; metasternum with scent-pores at posterior angles; anterior coxal cavities rounded externally, closed or nearly closed behind (Callichromini); antennæ longer than body in both sexes; prothorax acutely tuberculate laterally; frosted metallic greenish blue with golden tints; length 17 to 23 mm. ....*Chloridolum* (s. str.) *loochooanum*

28 (27). Anterior coxal cavities angulate externally (Compsocerini) 29

Anterior coxal cavities rounded, without exterior angles 30

29 (28). Third to fifth antennal segments densely tufted with black hairs apically; body narrow; elytra each with four smallish black spots; first near scutellum, the rest along middle of disc and equally spaced .... *Rosalia* (*Eurybatus*) *lesnei*

Third to fifth antennal segments not tufted with black hairs; body not very narrow, elytral spots not as above .... *Rosalia* (*Eurybatus*) *ferrici*

30 (28). Body strongly compressed dorso-ventrally; head oblique; frons very short (Callidini) 31

Body not strongly compressed, subcylindrical; head vertical in front; frons not very short (Clytini) 33

31 (30). Intercoxal process of prosternum only reaching part way between fore coxæ 32

Intercoxal process of prosternum reaching most of way between fore coxæ; elytra dark pitchy brown with two broad interrupted bands of ochraceous; pronotum pitchy, not metallic; length of body about 20 mm. .... *Semanotus japonicus*

32 (31). Pronotum flattened; mesonotum with stridulatory area not finely striolate; elytra red, or sometimes largely bluish with humeri red; pronotum bluish; length 7 to 12 mm. .... *Callidium Palæocallidium rufipenne*

Pronotum convex; mesonotum with stridulatory area finely striolate; black with a nearly straight, narrow white band across elytra at middle; length 7 mm. .... *Phymatodes* (*Paraphymatodes*) *albicinctus*

33 (30). Antennal insertions widely separated; frons, or frons and vertex, with some carinæ (*Xylotrechus*) 34

Antennal insertions not widely separated; frons and vertex without carinæ 36

34 (33). Dorsum dark with pale grayish or yellowish bands or stripes, those on anterior half of elytra largely longitudinal or transverse; pronotum dull 35

Dorsum largely orange with anterior portion of elytra black with oblique orange bands; pronotum crossed by orange, red, and black bands .... *Xylotrechus* (*Xyloclytus*) *chinensis*

35 (34). Prothorax distinctly angulate at each side behind middle; pronotal disc minutely rugulose; two median frontal carinæ fused above and below, forming a narrow ellipse; dorsal markings yellowish; pronotum with a small triangular yellow spot on each side of base .... *Xylotrechus* (s. str.) *atronotatus angulithorax*

Prothorax rounded at each side behind middle; pronotal disc densely granulose-punctate, two median frontal carinæ fused below only, separate from forked carina of occiput; dorsal markings gray; pronutum lacking two basal yellow spots .... *Xylotrechus* (s. str.) *atronotatus generosus*

36 (33). Antennæ not extremely slender, their insertions very close; third antennal segment not longer than scape (*Chlorophorus*) 37

Antennæ very slender, their insertions not extremely close; third segment longer than scape; pubescence greenish; elytra with three sometimes faint blackish bands; first sinuous, second and third incomplete, broader .... *Rhaphuma virens*

37 (36). Base of each elytron with a complete, closed lunule, or without any lunule 38

Base of each elytron with a lunule which is partly, or widely, open externally, and sometimes nearly open anteriorly as well. 39

38 (37). Base of each elytron with a complete, closed lunule which is quite long and connects with median band; apical portion with a large spot; pronotum with an inverted Y-shaped black mark, and an anterior black spot on each side as well; pubescence yellow .... *Chlorophorus annularis*

Base of each elytron with a narrow band instead of a lunule; a black transverse band at middle and another between it and apex; pubescence greenish .... *Chlorophorus muscosus*

39 (37). Base of each elytron with a lunule which is broadly open externally and connects behind with median band 40

Base of each elytron with a lunule which is partly closed anterolaterally, nearly open anteriorly, and incomplete posterolaterally, not connecting with median band; latter produced only a short distance anteriorly along suture; pubescence gray .... *Chlorophorus yayeyamensis*

40 (39). Basal lunule somewhat irregular, that of each side connected just behind scutellum; body orange; pubescence yellowish; pronotum with a complete, subtransverse black band; elytra with two complete black bands behind lunules .... *Chlorophorus quinquefasciatus*

Basal lunule C-shaped (on right elytron), not connected with its fellow; body dark, sometimes pitchy reddish on legs; pubescence gray to greenish gray; pronotum with two anteriorly fused oblique black spots on center and another anteriorly on each side. .... *Chlorophorus signaticollis*

41 (39). Tarsal claws simple, lacking teeth 42

Tarsal claws toothed or appendiculate basally; prothorax not tuberculate laterally 85

42 (41). Antennal scape with a cicatrix at apex; prothorax tuberculate laterally 43

Antennal scape without a cicatrix at apex; prothorax generally not tuberculate 57

43 (42). Cicatrix of antennal scape generally completely closed or margined Lamiini 44

Cicatrix of antennal scape not complete (open) 54

44 (43). Middle tibiæ with an external oblique groove before apex 45

Middle tibiæ without an external oblique groove before apex; mesosternal intercoxal process carinate; entirely grayish brown, rather narrow; length 21 to 25 mm. *Blepephæus decoloratus*

45 (44). Mesosternal intercoxal process neither tuberculate nor carinate 46

Mesosternal intercoxal process tuberculate or carinate 50

46 (45). Cicatrix of antennal scape open internally (*Dihammus*) 47

Cicatrix of antennal scape closed internally; body rusty to dark grayish with many small squarish spots of pale whitish gray, mostly in longitude stripes length 20 to 30 mm. .... *Monochamus alternatus*

47 (46). Dorsum with more or less golden or silvery buff pubescence, often lying in different directions on dark ground color, giving varying patterns 48

Dorsum evenly clothed with dense pale buff pubescence with a large dark brown spot at base of each elytron next to humerus; length 24 to 26 mm. .... *Dihammus subluscus maculihumerus*

48 (47). Elytra without any regular pattern, the pubescence lying in different directions 49

Elytra with a partial banding of darker and paler pubescence; antennæ reddish; length 25 to 35 mm. .... *Dihammus luxurious*

49 (48). Pubescence silvery buff, silky, fairly uniform; pronotum with numerous punctures; antennæ with whitish pubescence; length 27 mm. .... *Dihammus permutans okinawanus*

Pubescence dark greenish golden, lying in many different directions, given a broken and changeable pattern according to angle of light reflected; pronotum with rather few punctures; antennæ with gray to buff pubescence; length 22 to 30 mm. .... *Dihammus permutans paucipunctatus*

50 (45). Prothorax not very strongly tuberculate laterally; antennæ more than twice as long as body in male; inferior eye-lobe not deeper than wide (*Psacothea*) 51

Prothorax very strongly tuberculate laterally; antennæ not more than twice as long as body in male; inferior eye-lobe deeper than wide (*Anoplophora*) 52

51 (50). Elytra gray or nearly black, marked with conspicuous yellow or whitish spots of dense pubescence; prothoracic tubercles very small; pronotum without a transverse raised line across middle; length 15 to 25 mm. .... *Psacothea hilaris*

Elytra vaguely marked with large areas of dull gray pubescence; prothoracic tubercles of moderate size; pronotum with a transverse raised line across middle; length 22 to 26 mm. .... *Psacothea tenebrosa*

52 (50). Elytra bases with a number of rounded tubercles; body stout 53

Elytral bases without tubercles, smooth; elytra black marked with varying spots of white pubescence; body relatively narrow; length 24 to 32 mm. .... *Anoplophora* (s. str.) *glabripennis*

53 (52) Pronotal and elytral spots white or bluish white; often numerous and small; elytra black; length 25 to 35 mm. .... *Anoplophora* (s. str.) *macularia*

Pronotal and elytral spots yellow, mostly large and distinctly defined; length 28 to 35 mm. .... *Anoplophora* (s. str.) *macularia oshimana*

54 (43). Head touching coxæ in repose 55

Head not touching coxæ in repose (Batocerini); elytra with rounded tubercles basally; olive green, tubercles black; antennæ annulated, black and gray; length 30 to 45 mm. .... *Apriona germari*

55 (54,62). Middle tibia lacking an external preapical groove; antennal scape generally conical, gradually enlarging to apex; cicatrix often narrow (Mesosini) 56

Middle tibia with an external preapical groove; antennal scape swollen, subpyriform, with a large granulose area at apex forming a false cicatrix (Xenoleini); cylindrical; gray with irregular mottled pale pubescence; length 6 to 8.5 mm. .... *Xenolea tomentosa asiatica*

56 (55). Elytra black with three distinct sinuous ochereous bands; antennæ black and white; tibiæ annulated with black and tan; length 15 to 18 mm. .... *Mesosa* (*Saimia*) *cervinopicta*

Elytra brown of varying shades with a subbasal irregular band and a broad, zigzag central band, both of whitish; antennæ ringed with whitish tan and dark brown; tibæ ringed with whitish and dark brown; length 13.3 mm. .... *Mesosa* (*Saimia*) *pictipes*

57 (42). Tarsal claws divaricate, forming an angle of about 180 degrees. 58

Tarsal claws divergent, forming an angle of less than 90 degrees 64

58 (57). Elytra not carinate laterally 59

Elytra carinate laterally (Gleneini) 86

59 (58). Middle tibia with an external preapical groove 60

Middle tibia lacking an external preapical groove; head not retractile; antennæ much longer than body in male, with third segment swollen distally; frons trapeziform (Rhodopini); elytra with grayish yellow pubescence and with a number of glabrous spots, in part forming a vague postmedian band; length 12 mm. .... *Rhodopis okinawensis*

60 (59). Middle coxal cavities open externally to epimera; antennæ very long, closely inserted; antennal scape clavate, somewhat granulose (Dorcaschematini) 61

Middle coxal cavities closed to epimera externally, or only narrowly open 62

61 (60). Pale ochraceous, marked with a pair of large and two pairs of smaller chalky white spots on basal two-thirds of elytra, the large ones close to scutellum; prothorax as broad as long, transversely wrinkled; length 12 to 16 mm. .... *Olenecamptus bilobus nipponensis*

Reddish ochraceous, marked with two pairs of large white spots on pronotum and four pairs on elytra, the latter covering most of discal surfaces; prothorax longer than broad, not conspicuously wrinkled; length 10 to 12 mm. .... *Olenecamptus octopustulatus formosanus*

62 (60). Antennal scape lacking a granular area or cicatrix-like depression apically 63

Antennal scape swollen distally, with a granular cicatrix-like area at end of upper surface; antennæ longer than body (Xenoleini) .... See bract 55

63 (62). Anterior coxal cavities angulate externally (Estolini) 79

Anterior coxal cavities rounded externally (Acanthocinini) 83

64 (57). Middle coxal cavities distinctly open externally to epimera 65

Middle coxal cavities not distinctly open externally to epimera; antenal insertions widely separated; antennæ slender, slightly longer than body (Ptericoptini); length 7 to 10 mm. 76

65 (64). Middle tibia with a distinct preapical oblique groove 66

Middle tibia without a distinct preapical oblique groove (Niphonini) 69

66 (65). Frons squarish or much broader than long, and oblong 67

Frons trapeziform, narrower above; antennal supports prominent; somewhat opisthognathous; antennæ much longer than body (Hippopsini) 80

67 (66). Frons broadly oblong; head and prothorax as broad as elytra; antennæ about as long as body (Bumetopin); length 10 to 13 mm. 68

Frons squarish or slightly wider above than below; head and prothorax narrower than elytra; antennæ generally shorter than body (Apomecynini); pronotum with a cross formed of small white spots and elytra with oblique rows of white spots .... *Apomecyna maculaticollis*

68 (67). Third antennal segment about one and one-half times as long as scape; inferior eye-lobe shallower than gena .... *Bumetopia oscitans plagiata*

Third antennal segment twice as long as scape; inferior eye-lobe deeper than gena .... *Bumetopia oshimana*

69 (65). Prothorax not tuberculate anteriorly at sides; not very broad 70

Prothorax tuberculate anteriorly at sides; head and prothorax broad, nearly as broad as elytra; dark pitchy brown with tawny pubescence, denser on two broad vague transverse bands across elytra; length 17 to 22 mm. .... *Abryna coenosa*

70 (69). Mesosternal intercoxal process vertical anteriorly; elytra not steeply declivitous posteriorly; antennæ about as long as body; pronotum longitudinally corrugate (*Niphona*) 71

Mesosternal intercoxal process oblique anteriorly; elytra rather steeply declivitous posteriorly; antennæ shorter than body (*Pterolophia*) 72

71 (70). Elytra smooth with a subbasal crest on each, separately subacute apically, reddish brown with even pale tawny pubescence with some vague paler areas; length 13 to 21 mm. .... *Niphona furcata*

Elytra rugose bassally, emarginate-truncate apically; blackish brown with irregular reddish brown pubescence; length 16 to 19 mm. .... *Niphona yanoi*

72 (70). Each elytron with a distinct swelling behind base 73

Each elytron with a very feeble or indistinct swelling behind base 74

73 (72). Elytra separately somewhat rounded at apices; body clothed with reddish pubescence with a broad pale gray area across middle of elytra narrowing toward suture; length 11 to 13 mm. .... *Pterolophia annulata*

Elytra obliquely truncate internally at apices; body clothed with grayish white pubescence irregularly spotted with brown, with a transverse black band across elytra above posterior declivity; length 10 mm. .... *Pterolophia latefascia*

74 (72). Elytra largely clothed with fairly even brown pubescence 75

Elytra clothed with spots of yellowish pubescene with a gray oblique band behind middle; length 6 mm. .... *Pterolophia loochooana*

75 (74). Prothorax about as long as broad; elytra brown with apical declivity paler; length 11 to 14 mm. .... *Pterolophia obscura*

Prothorax shorter than broad; elytra with a narrow sinuous band just behind middle of each; length 8 to 10 mm. .... *Pterolophia cænosa*

76 (64) Elytra with apex of each obtuse or approximately forming a right angle, not acuminately produced 77

Elytra with apex of each acuminately produced; pubescence pale to dark brown with partial paler stripes on some of interstices .... *Sybra ordinata*

77 (76). Body rather flattened, not very convex; apical declivity of elytra not largely pale in contrast to dark area preceding 78

Body shorter, more convex; apical declivity of elytra pale in contract to nearly blac karea preceding it .... *Sybra baculina*

78 (77). Elytra each with a round dark spot near base, a longitudinal one in center and an oblique one before apex. .... *Sybra loochooana*

Elytra grayish brown with incomplete pale longitudinal stripes on some of interstices; sutural puncture-row distinctly impressed .... *Sybra punctatostriata*

79 (68). Scape swollen, hardly one-half as long as third antennal segment; vertex rounded-concave; pronotum wih five arong ridges; elytra largely pale buff except for a basal triangle and a broad triangle at each side of middle, with a small tubercule at apex of latter, near suture; length 10 to 11 mm. .... *Diboma costata*

Scape fusiform-cylindrical, not much shorter than third segment; vertex feebly concave; pronotum without strong ridges; elytra largely fawn brown with some paler markings postbasally and preapically, not tuberculate near middle; length 10 to 14 mm. .... *Doius meridianus*

80 (66). Hind femora reaching only to posterior margin of first abdominal segment or very slightly beyond 81

Hind femora reaching at least to middle of second abdominal segment; body almost entirely clothed with pale pubescence, thicker on five stripes on prothorax and three or four on each elytron, the stripes buffy and not well defined; hairs on underside of scape nearly as long as those of third segment; length 12 to 14 mm. .... *Pothyne albolineata*

81 (80). Antennæ about twice as long as body; elytra striped with pale; length under 16 mm. 82

Antennæ much less than twice as long as body, stouter basally, of 12 distinct segments; elytra with many small ochreous spots partly formed in rows; length over 19 mm. .... *Pothyne variegata*

82 (81). Elytral apices obliquely truncate; punctures of sides of pronotal disc separated by spaces several times as large as their diameters, punctures of elytral bases somewhat smaller than interspaces .... *Pothyne formosana*

Elytral apices subtransversely truncate; punctures of sides of pronotal disc separated by spaces in part smaller than their diameters, punctures of elytral bases about as large as interspaces .... *Pothyne liturata*

83 (63). Scape shorter than third antennal segment; body rather dorsoventrally compressed; length less than 7 mm. (*Misænia* 84

Scape as long as third antennal segment; body not strongly compressed; mottled gray with two short dark lines on base of pronotum and a brown spot on side of each elytron; length 14 mm. .... *Lagocheirus obsoletus*

84 (83). Elytra without a distinct band; length 2.9 mm. .... *Misænia brevicollis*

Elytra with a more or less distinct band; length 4.8 to 6 mm. .... *Misænia sakishimana*

85 (41). Elytra carinate laterally; first three or four abdominal segments decreasing in length posteriorly (Gleneini) 86

Elytra not carinate laterally; first four abdominal segments subequal in length (Phytoeciini) 89

86 (58, 85). Elytra obliquely truncate and often emarginate apically, with ectoapical angles acuminately produced 87

Elytra transversally truncate apically with ectoapical angles briefly angulate; each elytron with seven metallic silver-green spots; legs black; length 9 to 11 mm. .... *Glenea* (s. str.) *chlorospila*

87 (86). Each elytron with three or four longitudinal yellow or whitish stripes 88

Each elytron with two narrow silver-green stripes, one sutural and one humeral, both meeting narrow apical band; prothorax with three broad stripes and frons entirely covered with silver-green; length 11 to 12 mm. .... *Glenea* (s. str.) *iwasakii*

88 (87). Each elytron with one sutural, one discal, one humeral and one lateral stripe of yellowish; length 10 to 13 mm. .... *Glenea* (s. str.) *lineosa lineosa*

Each elytron with discal stripe incomplete, consisting of a slightly oblique stripe ending anterior to middle, followed by a short longitudinal spot just behind middle, besides apical spot; length 9 to 13 mm. .... *Glenea* (s. str.) *lineosa sauteri*

89 (85). Elytra largely black or grayish black; length generally more than 12 mm. 90

Elytra entirely testaceous brown; length 11 mm. .... *Oberea bicoloripes insigakiana*

90 (89). Elytra pale yellowish testaceous on basal sixth, black on remainder; legs entirely pale yellow; length over 16 mm. .... *Oberea japonica*

Elytra pale only adjacent to scutellum, remainder slaty black with pale pubescence; legs black on distal halves; length under 14 mm. .... *Oberea griseopennis*

Subfamily PRIONINÆ

Tribe EURYPODINI

1. EURYPODA (NEOPRION) BATESI Gahan

Eurypoda batesi Gahan, Ann. Mag. Nat. Hist. (6) 14 (1894), 225 (Japan); Mitono, Cat. Col. Jap. 8 (1940) 3 (Amami-Oshima, Okinawa).

Amami-Oshima and Okinawa (Nago). Also Japan.

Tribe MEGOPIDINI

2. MEGOPIS (AEGOSOMA) SINICA SINICA (White)

Aegosoma sinicum White, Cat. Col British Mus. 7 (1853) 30 (Shanghai).

Megopis sinica Kato, Three Colour Ill. Ins. Japan 9 (1933) *pl. 16, fig. 12;* Mitono, Cat. Col. Jap. 8 (1940) 6 (Amami-Oshima, Okinawa).

Hosts.—Populus, Fraxinus, Mallotus, Salix and Pinus.

Amami-Oshima and Okinawa. Also Japan, Formosa, Korea and China.

3. MEGOPIS (AEGOSOMA) VALIDICORNIS sp. nov.

Male.—Body reddish brown, paler or pitchy in part, clothed with oblique, golden hairs above and with more erect, longer, pale golden hairs beneath; hairs shorter and closer on elytra, giving a tawny appearance. Antennæ more glabrous and shiny; head and prothorax slightly shiny.

Head large, nearly twice as long as prothorax, as broad at genal angles as at swollen part of neck behind eyes; genæ large, expanded at angles; mandibles more than one-half as long as remainder of head, irrigular externally but untoothed internally; surface of head irrigularly granulose, finely and shallowly grooved along median line; inferior eye-lobe separated from genal angle by a space greater than its longtitudinal diameter; underside of head flat and strongly tuberculate. Antennæ about as long as body, very stout; first five segments strongly spined, particularly on third segment, the spines stronger on inner sides; third longer than fourth and fifth combined, reaching well behind humeri; fourth two-thirds again as long as fifth; fifth nearly as long as sixth to eighth combined. Prothorax three-fourths again as broad as long, one-half again as broad at base as at apex, rounded at sides, with hardly a suggestion of an angle at middle; disc strongly convex, particularly on middle of each side, and closely and strongly granulate, feebly depressed along median line. Scutellum broadly triangular and emarginate apically, asperate-punctate. Elytra gradually narrowed posteriorly from a short distance behind humeri, rounded apically; disc of each with two prominent raised lines, meeting at beginning of apical fifth, and two less distinct costæ externally, meeting fusion of first two, with several branches near apex; surface irregularly subasperate-punctate, stongly granulose on two major costæ and near suture, with a few scattered granules on humeri. Ventral surfaces minutely punctured; last abdominal sternite with a round emargination apically. Legs punctured or granulose; last hind tarsal segment about as long as first three combined. Length 64.5 millimeters; breadth 18.

Holotype.—Male (Taiwan Agric. Res. Inst.), Ishigaki (Yaeyama), Yaeyama Subgroup, Sakishima Group, Southern Ryukyu Islands, June 19, 1937, K. Seki.

Differs from *M.* (*Aegosoma*) *sinica sinica* (White) as follows: larger, prothorax more convex and more rounded at sides, elytra paler, antennæ stouter and more tuberculate, and scape more cylindrical.

Subfamily ASEMINÆ

Tribe SPONDYLINI

4. SPONDYLIS BUPRESTOIDES (Linnaeus)

Attelabus buprestoides Litimaers, Syst, Nat. ed. 10 (1758) 388 (Europe).

Spondylis buprestoides Kato, Three Colour Ill. Ins. Japan 9 (1933) *pl. 15, fig. 15;* Mitono, Cat. Col. Jap. 8 (1940) 1 (Okinawa).

Hosts.—Pinus.

Okinawa, also Japan, Korea, China, Siberia and Europe.

Tribe LEPTURINI

5. LEPTURA (s. str.) AURATOPILOSA (Matsushita)

Strangalia aurotopilosa Matsushita, Trans. Capporo Nat. Hist. Soc. 12 (1931) 42 (Formosa); Ins. Matsumurana 15 (1941) 158 (Amami-Oshima).

Amami-Oshima; Also Formosa.

6. LEPTURA (PEDOSTRANGALIA) COCCINEA (Mitono)

Strangalia (s. str.) *coccinea* Mitono, Trans. Nat. Hist. Soc. Formosa 26 (1936) 423 (N. Formosa); type in Taiwan Agric. Res. Inst.).

Strangalia (*Paranaspia*) *coccinea* Tamanuki. Fauna Nipponica 10 (1942) 8, 15, 165, *fig. 202* (Ryukyu).

Ryukyu; also N. Formosa.

7. STRANGALIA (s. str.) GRACILIS Gressitt

Strangalia (*Strangalina*) *gracilis* Gressitt, Philip. Jour. Sci. 55 (1934) 381 (Amami-Oshima); (type in C. A. S.).

Strangalia (*Strangalina*) *takeuchii* Matsushita et Tamanuki, Ins. Matsumurana 10 (1935) 2, *fig. 2* (Honshu).

Amami-Oshima; also Japan.

8. STRANGALIA (s. str.) LONGICORNIS Gressitt

Strangalia (*Strangalina*) *longicorne* Gressitt, Philip. Jour. Sci. 55 (1934) 382 (Amani-Oshima); (type in U. S. N. M.).

Amami-Oshima. Endemic.

Subfamily CERAMBYCINÆ

Tribe ACHRYSUNINI

9. NORTIA CARINICOLLIS Schwarzer

Nortia carinicollis Schwarzer, Ent. Blätt. 21 (1925) 20 (Formosa); Matsushita, Kontyu 12 (1938) 94 (Okinawa).

Okinawa; also Formosa.

Tribe CERAMBYCINI

10. MARGITES FULVIDUS (Pascoe)

Cerambyx fulvidus Pascoe, Trans. Ent. Soc. London (2) 4 (1858) 236 (N. China); (type in Brit. Mus.).

Several were taken on Okinawa in 1914 by J. E. A. Lewis. Previously unrecorded.

Okinawa. Also Formosa, Japan, and N. China.

Tribe HESPEROPHANINI

11. STROMATIUM LONGICORNE (Newman)

Arhopalus longicornis Newman, Entomologist 1 (1842) 246 ("Manila").

Stromatium asperulum White, Cat. Col. British Mus. 8 (1855) 300 (Hong Kong).

"*Criocephalus granulatus* Matsumura", Sakaguchi, 1927, Prov. Lists Ins. Okinawa; nom. nud.

Stromatium longicorne Yashiro, Okinawa Sugar Exp. Sta. Bull. 1 (1927) 8 (Amami-Oshima; Okinawa); Kato, Three Colour Ill. Ins. Japan 9 (1933) *pl. 18, fig. 2;* Esaki, Botany and Zoology 1 (1933) 1648; Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 18 (Iriomote).

Some (C.A.S.) taken at Iriomote, Nago, and Nase by me in July 1932; one (Taiwan Agric. Res. Inst.) N. Daito-jima (O-agari) three degrees east of Okinawa.

Host.—A common pest boring in houses and furniture.

Amami-Oshima, Tokunoshima, Okinawa, Miyako, Ishigaki, and Iriomote; also Formosa, S. China, SE. Asia, the Philippines and Malay Archipelago.

Tribe PHORACANTHINE

12. ALLOTRAEUS (NYSINA) ASIATICUS (Schwarzer)

Neosphærion asiaticum Schwarzer, Ent. Blätter 21 (1925) 22 (Formosa).

Allotræus asiaticus Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 297 (Okinawa).

Okinawa; also Formosa, S. China, and Tonkin.

13. ALLOTRAEUS (NYSINA) INSULARIS (Mitono), comb. nov.

Pseudallotræus insularis Mitono, Mushi 18 (1947) 25 (Irimote); (description in Japanese only).

Iriomote, Endemic.

Tribe CALLIDIOPINI

14. STENYGRINUM QUADRINOTATUM Bates

Stenygrinum quadrinotatum Bates, Ann. Mag. Nat. Hist. (4) 12 (1873) 154 (Japan); (type in Brit. Mus.); Esaki, Hori, and Yasumatsu, Ins. Jap. Ill. Icon. (1938) *pl. 139, fig. 543:1;* Mitono, Cat. Col. Jap. 8 (1940) 67 (Tokunoshima).

One (C.A.S.) Amami-Oshima.

Host.—Castanea.

Amami-Oshima, Tokunoshima; also Japan, Korea, China Burma, N. India.

15. CERESIUM ELONGATUM Matsushita

Ceresium elongatum Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 301 (Okinawa); (type in Hokkaido Univ.).

A female (Taiwan Agric Res. Inst.) questionably belonging to this species, described from an unique male, was taken at Shuri, Okinawa, April 19, 1941, R. Matsuda.

Okinawa. Endemic.

16. CERESIUM FLAVIPES (Fabricius)

Callidium flavipes Fabricius, Ent. Syst. 12 (1792) 327 "Cape of Good Hope").

? "*Ceresium brunneum*" Sakaguchi, 1927, Prov. Lists Ins. Okinawa; nom. nud.

Ceresium flavipes Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 18 (Iriomote); Matsushita, Ins. Matsumurana 7 (1933) 67 (Okinawa; Ishigaki).

One (C.A.S.) Nishibaru, Okinawa, June 1918, H. Yashiro.

Okinawa, Ishigaki, and Iriomote; also Formosa, the Philippines, East Indies, SE Asia, etc.

17. CERESIUM FUSCUM Matsumura et Matsushita

?"*Ceresium okinawensis* Matsumura", Sakaguchi, 1927, Prov. Lists Ins. Okinawa; nom. nud.

Ceresium fuscum Matsumura et Matsushita, Ins. Matsmurana 7 (1932) 67, *fig. 1* (Okinawa); (type in Hokkaido Univ.).

One (C. A. S.) Nago, Okinawa, May 1945, R. and G. Bohart; several (Taiwan Agric. Res. Inst.) Ishigaki, March and May, 1933, S. Hirayama; April 1941, R. Matsuda; June 1932, A. Umeno; Chinasan, Okinawa, June 1932, K. Nomura; Iriomote, July 1932, S. Hirayama, and March 1934, K. Nomura.

Okinawa, Ishigaki, and Iriomote. Endemic.

18. CERESIUM HOLOPHAEUM Bates

Ceresium holophæum Bates, Ann. Mag. Nat. Hist. (4) 12 (1873) 153 (Japan); (type in Brit. Mus.); Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 301 (Okinawa).

Okinawa; also Hokkaido and Honshu.

19. CERESIUM SINICUM White

Ceresium sinicum White, Cat. Col. Brit. Mus. 8 (1855) 245 (N. China); (type in Brit. Mus.).

?*Ceresium sinicum* Sakaguchi, 1927, Prov. Lists Ins. Okinawa.

One (Taiwan Agric. Res. Inst.) Ishigaki, May 1933, S. Hirayama.

Ishigaki, Okinawa (?); also Formosa and S. China.

20. CERESIUM ZEYLANICUM LONGICORNE Pic

Ceresium longicorne Pic, Mel. Exot. Ent. 45 (1926) 24 (Formosa); Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 302 (Okinawa).

Some (Taiwan Agric. Res. Inst.) Iriomote, May 1932, S. Hirayama, and July 1932, T. Shiraki.

Okinawa and Iriomote; also Kyushu and Formosa.

21. NEOSALPINIA LEPTUROIDES Matsushita

"*Vesperus badius* Matsumura", Sakaguchi, 1927, Prov. Lists Ins. Okinawa; nom. nud.

Neosalpinia lepturoides Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 304, *pl. 11, figs. 15a–b* (Okinawa); (type in Hokkaido Univ.).

Okinawa; also Yakushima, Kyushu, and Shikoku.

Tribe OBRIINI

22. STENHOMALUS CLEROIDES Bates

Stenhomalus cleroides Bates, Ann. Mag. Nat. Hist. (4) 12 (1873) 155 (Japan); (type in Brit. Mus.); Gressitt, Ins. Matsumurana 9 (1935) 148 (Miyako); Mitono, Cat. Col. Jap. 8 (1940) 65 (Ishigaki).

Miyako and Ishigaki; also Japan (Hokkaido, Honshu and Kyushu).

23. IPHROBRIUM DILATIPENNE Gressitt

Iphrobrium dilatipenne Gressitt, Ins. Matsumurana 9 (1935) 151 (Iriomote); (type in C.A.S.).

One (C.A.S.) Chizuka, Okinawa, July-September, 1945, Bohart and Bohart.

Okinawa and Iriomote. Endemic.

24. PSEUDIPHRA OBSCURA sp. nov. Fig. 1.

Pseudiphra apicale Mitono (*nec.* Schwarzer), Cat. Col. Jap. 8 (1940) 64 (part: Amami-Oshima).

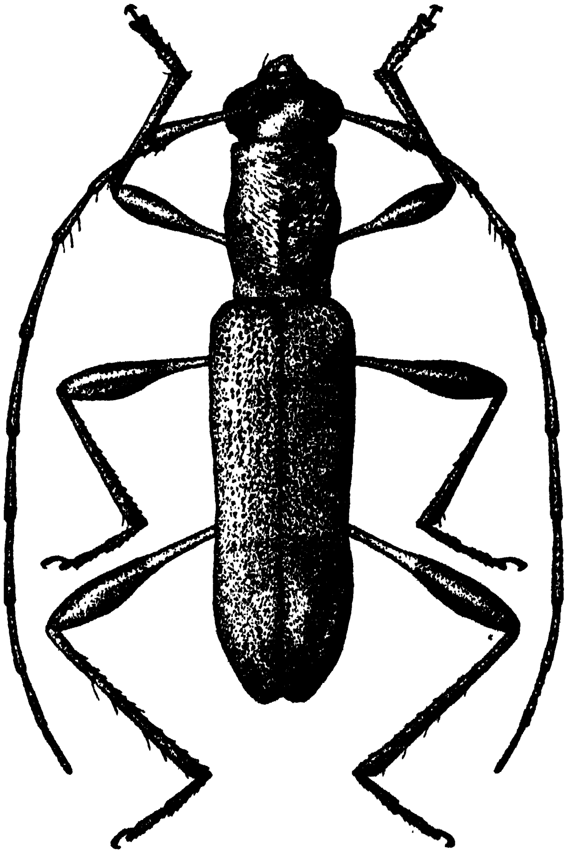

FIG. 1. *Pseudiphra obscura* sp. nov.

Male.—Reddish brown, in part testaceous or pitchy; head duller reddish brown; antennæ reddish, duller on scape and apices of following segments, paler on last three segments; prothorax pale castaneous; elytra dull reddish brown, gradually becoming dusky in posterior two-fifths; ventral surfaces reddish on prosternum, dull testaceous on mesosternum, dusky brownish on metasternum and pitchy brown on abdomen; femora testaceous basally, pitchy brown on swollen portions; tibiæ dusky reddish brown; tarsi paler. Body surfaces very finely clothed with pale silky pubescence, less distinct on first eight antennal segments; basal antennal segments with a few oblique hairs beneath.

Head slightly broader, and distinctly shorter, than prothorax, rather smooth and minutely punctulate, finely grooved medially on frons and vertex, transversely and more deeply grooved on apex of frons; eyes distant above, very close to genal margins anteriorly, about one-half as deep as depth of head. Antennæ nearly one-third again as long as body; third and fourth segments thickened at apices and last thickened in middle; scape thickest somewhat before apex, slightly longer than second and third combined; fourth little shorter than third; fifth as long as scape, slightly longer than sixth; sixth to eighth subequal last three shorter. Prothorax fully one-third longer than broad, somewhat convex at side, constricted anteriorly and posteriorly, broader at apex than base; anterior collar somewhat convex at sides; disc even, micropunctulate. Scutellum small and narrowed behind. Elytra subparallel, slightly narrower at middle than at humeri and in apical third, rounded apically; disc of each deeply punctured in about nine rows on nearly basal two-thirds, irregularly interiorly, impunctate posteriorly. Ventral surfaces micropunctulate; first abdominal segment hardly as long as remaining combined. Femora pedunculate-clavate, fore pair most strongly clavate; hind pair barely exceeding elytral apices; tibiæ slender and straight; hind tarsi with first segment as long as next two combined. Length 4.7 millimeters, breadth 0.95.

Holotype.—Male (Taiwan Agric. Res. Inst.), Nishinakama, Amami-Oshima, N. Ryukyu, July 28, 1932, T. Shiraki.

Differs from *P. apicale* (Schwarzer) in having the antennæ less fringed beneath, the prothorax less cylindrical at each end and distinctly broader at middle than apex, the elytra less densely, less regularly and less extensively punctured and the coloration less contrasted.

Tribe MOLORCHINI

25. MOLORCHUS (LINOMIUS) TAKEUCHII Ohbayashi

Molorchus takeuchii Ohbayashi, Nippon no Kochu 1 (1937) 6 (Yakushima); Seki, Ins. World 48 (1944) 12 (Amami-Oshima).

Molorchus (*Linomius*) *takeuchii* Hayashi, Konchugakuhyoron (Ent. Review) 1 (1948) 5–9, *pl. 1, fig. 4* (Kyushu).

Amami-Oshima; also Yakushima and Kyushu. Hayashi seems to question Seki's for Amami-Oshima.

Tribe CALLICHROMINI

26. CHLORIDOLUM LOOCHOOANUM Gressitt

Chloridolum loochooanum "Gressitt" Kato, Ent. World 1 (1933) 557, *fig. 3* (*nom. nud.*); Gressit, Pan-Pac. Ent., 9 (1934) 163 (Amami-Oshima), (type in C.A.S.); Esaki, Hori and Yasumatsu, Ins. Jap. Ill. Icon. (1938), *pl. 139, fig. 541:1;* Gressitt, Fichier Ent. Chinois 1 (1939) *pls. 9–10.*

Amami-Oshima. Endemic.

Tribe COMPSOCERINI

27. ROSALIA (EURYBATUS) FERRIEI Vuillet

Rosalia (*Eurybatus*) *ferriei* Vuillet, Insecta 1 (1911) 79, *fig.* (Amami-Oshima).

Amami-Oshima. Endemic.

28. ROSALIA (EURYBATUS) LESNEI Boppe

Rosalia lesnei Boppe, Bull. Soc. Ent. France (1911) 103, *figs. 1–2* (Formosa); Kato, Three Colour Ill. Ins. Jap. 9 (1933) *pl. 16, fig. 6.*

Eurybatus (*Eurybatorosalia*) *lesnei* Plavilshikov. Faune URSS 22 (1940) 675.

One (C.A.S.) Ishigaki, 1911, J. C. Thompson. Previously unrecorded.

Ishigaki; also Formosa.

Tribe CALLIDIINI

29. SEMANOTUS JAPONICUS (Lacordaire)

Sympiezocera japonica Lacordaire, Gen. Col. 9 (1869) 47, note 2 (Japan).

Semanotus japoicus Esaki, Hori and Yasumatsu. Ins. Jap. Ill. Icon. (1938) *pl. 139, fig. 541: 2.*

One specimen from Okinawa was seen in 1934 in the collection of the Naha Sugar Experiment Station, which was destroyed in 1945. Possibly introduced in lumber from Japan.

Host.—Cryptomeria japonica.

Okinawa (introduced?); also Japan (Honshu, Shikoku, and Kyushu); questionably Formosa.

30. CALLIDIUM PALAEOCALLIDIUM RUFIPENNE Motschulsky

Callidium rufipenne Motschulsky, Etudes Ent. 9 (1860) 19 (Japan); Esaki, Hori and Yasumatsu, Ins. Jap. Ill. Icon. (1938) *pl. 139, fig. 540:1–2;* Mitono, Cat. Col. Jap. 8 (1940) 103 (Amami-Oshima, Okinawa).

The work of this species was observed at Nase, Amami-Oshima, in 1932, and specimens were seen in the Nase Experiment Station.

Host.—Cryptomera japonica.

Amami-Oshima and Okinawa; also Japan (Hokkaido to Kyushu) and Formosa.

31. PHYMATODES (PARAPHYMATODES) ALBICINCTUS Bates

Callidium albofasciatum Motschulsky (*nec* Bland), Bull. Soc. Nat. Moscou 39 (1866) 174 (Japan).

Phymatodes albicinctus Bates, Ann. Mag. Nat. Hist. (4) 12 (1873) 198 (Japan); (type in Brit. Mus.).

Phymatodes (Paraphymatodes) albicinctus Plavilstshikov, Faune URSS 22 (1940) 701 (Ryukyu).

Ryukyu Islands (No island specified); also Japan and Korea.

Tribe CLYTINI

32. XYLOTRECHUS (XYLOCLYTUS) CHINENSIS (Chevrolat)

Clytus chinensis Chevrolat Rev. Mag. Zool. (2) 4 (1852) 416 (China).

Xylotrechus sinensis Sakaguchi, 1927, Prov. List Ins. Okinawa.

Xylotrechus chinensis Yashiro, Okinawa Sugar Exp. Sta. Bull. 1 (1927) 8 (Okinawa); Esaki, Hori and Yasumatsu, Ins. Jap. Ill. Icon. (1938) *pl. 139, fig. 540: 3;* Mitono, Cat. Col. Jap. 8 (1940) 106 (Tokunoshima).

Host.—Morus alba; Pyrus malus.

Okinawa and Tokunoshima. Also Japan, Korea, Formosa, E. China and Manchuria.

33. XYLOTRECHUS (s. str.) ATRONOTATUS ANGULITHORAX Gressitt

Xylotrechus angulithorax Gressitt, Pan-Pacific Ent. 9 (1934) 165 (Amami-Oshima); (type in C.A.S.).

Xylotrechus basalis var. *generosus* Miwa, Trans. Kansai Ent. Soc. 6 (1935) 25, *pl. 4, fig. 14* (Okinawa and Amami-Oshima).

Xylotrechus basalis angulithorax Mitono, Cat. Col. Jap. 8 (1940) 106 (part: Tokunoshima).

Xylotrechus atronotatus angulithorax Mit., Bull. Agr. For. Taihoku Univ. 2 (1941) 91, *pl. 7, figs. 6–7* (part).

Amami-Oshima (Gusuku); Tokunoshima; Okinawa (?). Endemic. Mitono in 1941 did not list Okinawa.

34. XYLOTRECHUS (s. str.) ATRONOTATUS GENEROSUS

Xylotrechus generosus Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 270, *pl. 11, fig. 1* (Yayeyama); (type in Hokkaido Univ.).

Xylotrechus basalis Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 18 (Iriomote).

Xylotrechus basalis angulithorax Mitono, Cat. Col. Jap. 8 (1940) 106.

Xylotrechus atronotatus angulithorax Mitono, Bull. Agr. For. Taihoku Univ. 2 (1941) 91, *pl. 7, figs. 6–7* (part: Yaeyama and Iriomote).

One (C.A.S.) was taken by the writer on Ishigaki in August 1934.

Ishigaki (Yaeyama) and Iriomote. Endemic.

35. CHLOROPHORUS ANNULARIS (Fabricius)

Callidium annulare Fabricius, Mant. Ins. 1 (1787) 156 (Siam).

Callidium bidens Weber, Obs. Ent. (1801) 90 (E. India).

Chlorophorus annularis Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 18 (Iriomote); Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 280 (Okinawa); Miwa, Trans. Kansai Ent. Soc. 6 (1935) 25 (Amami-Oshima).

Host.—Bamboos.

Present on all the large islands; also Japan, Formosa, S. Asia, E. Indies, etc.

36. CHLOROPHORUS MUSCOSUS (Bates)

Clytanthus muscosus Bates, Ann. Mag. Nat. Hist. (4) 12 (1873) 198 (Japan); (type in Brit. Mus.).

Chlorophorus bifasciatus Kano, Kontyu 7 (1933) 135 (Izu-Oshima I., near Tokyo Bay).

Chlorophorus muscosus Gressitt, Kontyu 11 (1937) 321 (Amami-Oshima).

Amami-Oshima. Also Japan (Honshu, Shikoku, Kyushu, Sado, Izu-Oshima and Hachijo).

37. CHLOROPHORUS QUINQUEFASCIATUS (Castelnau et Gory)

Clytus quinquefasciatus Cast. et Gory, Hist. Nat. Icon. Ins. Col. (1841) 101, *pl. 19, fig. 120* (Japan).

Chlorophorus quinquefasciatus Kano, Trans. Nat. Hist. Soc. Formosa 16 (1927) 128 (Loochoo); Miwa, op, cit. 23 (1933) 18 (Iriomote); Kato, Three Colour Ill. Ins. Japan 9 (1933) *pl. 15, fig. 1*; Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 285 (Okinawa, Ishigaki); Mitono, Cat. Col. Jap. 8 (1940) 119 (Amami-Oshima, Miyako).

Some (C.A.S.) were taken at Nago, Okinawa, by the writer in July 1932.

Host.—Prunus cerasus.

Found on all the main islands; also Japan (Honshu, Shikoku, Kyushu, Yakushima) and Korea.

38. CHLOROPHORUS SIGNATICOLLIS (Castelnau et Gory)

Clytus signaticollis Castelnau et Gory, Hist. Nat. Icon. Ins. Col. (1841) 108, *pl. 19, fig. 122* ("E. India").

Chlorophorus signaticollis Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 13 (Iriomote); Trans. Kansai Ent. Soc 6 (1935) 25 (Amami-Oshima, Ishigaki); Mitono, Cat. Jap. 8 (1940) 120 (Okinawa).

Some (C.A.S. and Lingnan) were taken at Nase, Amami-Oshima, by the writer in July 1932.

Amami-Oshima, Okinawa, Ishigaki, and Iriomote; also Formosa and E. China.

39. CHLOROPHORUS YAYEYAMENSIS Kano

Chlorophorus yayeyamensis Kano, Kontyu 7 (1933) 137 (Ishigaki, Iriomote).

Chlorophorus dubius Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 281, *pl. 11, fig. 5* (Formosa, Okinawa); (type in Hokkaido Univ.).

Some (C.A.S. and Lingnan) Nago, Okinawa, July 1932, Gressitt; (Taihoku Agric. Res. Inst.) Amami-Oshima, T. Shiraki; Miyaako, June 1932, A. Umeno.

Amami-Oshima, Okinawa, Miyako, Ishigaki and Iriomote; also Formosa.

40. RHAPHUMA VIRENS Matsushita

Rhaphuma virens Matsushita, Mitteil. Zool. Mus. Berlin 17 (1931) 402 (Formosa); Mitono, Cat. Col. Jap. 8 (1940) 124 (Amami-Oshima); Bull. Agr. For. Taihoku Univ. 3 (1942) 93, *pl. 9, fig. 7.*

Amami-Oshima; also Formosa.

Subfamily LAMIINÆ

Tribe LAMIINI

41. PSACOTHEA HILARIS (Pascoe)

Monohammus hilaris Pascoe, Trans. Ent. Soc. London (2) 4 (1857) 103 (N. China); (type in Brit. Mus.).

Psacothea hilaris Sakaguchi, 1927, Prov. List Ins. Okinawa; Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 12 (Iriomote); Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 322 (Okinawa, Yaeyama); Miwa, Mushi 8 (1935) 38 (Yonakuni); Esaki, Hori and Yasumatsu, Ins. Jap. Ill. Icon. (1938) *pl. 138, fig. 536: 1.*

Psacothea hilaris albomaculata Kano, Kontyu 6 (1933) 278 (Formosa; Ishigaki).

Specimens from Amami-Oshima were seen in the Nase Experiment Station in 1932.

Host.—Morus, Ficus.

Amami-Oshima, Okinawa, Ishigaki, and Iriomote; also Japan, Formosa, Korea, China, and Tonkin.

42. PSACOTHEA TENEBUROSA Matsushita

Psacothea teneburosa Matsushita, Jour. Fac. Hokkaido Univ. 34 (1933) 322, *pl. 5, fig. 8* (Okinawa); (type in Hokkaido Univ.).

One (C.A.S.) Shuri, Okinawa, taken by the writer in August 1934; Kume I., June 1931, H. Yashiro: (Taiwan Agric. Res.

Inst.) Miyako I., June 1932, J. Sonan; Nago, Okinawa, K. Nakamura.

This species was mistakenly synonymized with *hilaris* by Mitono.

Okinawa, Kume, and Miyako. Endemic.

43. MONOCHAMUS ALTERNATUS Hope

Monochamus alternatus Hope, Proc. Ent. Soc. London (1842) 111 (Chusan, E. China).

Monohammus tesserula White, Proc. Zool, Soc. London 26 (1858) 408 (Hong Kong); Esaki, Hori and Yasumatsu, Ins. Jap. Ill. Icon. (1938) *pl. 138, fig. 536: ♀;* Mitono, Cat. Col. Jap. 8 (1940) 142 (Okinawa).

The work of this species was observed by the writer on Okinawa in 1945.

Host.—*Pinus luchuensis.*

Okinawa I. Also Japan, Formosa, Korea, S. China.

44. DIHAMMUS LUXURIOSUS (Bates)

Monohammus luxuriosus Bates, Ann. Mag. Nat. Hist. (4) 12 (1873) 309 (Japan); (type in Brit. Mus.).

Dihammus luxuriosus Yokoyama, (Coleopt. of Japan) 1 (1932) *pl. 4, fig. 2;* Mitono, Cat. Col. Jap. 8 (1940) 44 (Okinawa).

A specimen from Amami-Oshima was seen in the Nase Agriculture Experiment Station in 1932. The Okinawa specimen in the Taiwan Agric. Res. Inst. collection is from Nago.

Hosts.—*Abies, Kalopanax, Aralia, Fatsia.*

Amami-Oshima and Okinawa; also Japan, Korea, N. China.

45. DIHAMMUS PERMUTANS OKINAWANUS subsp. nov. Fig. 2.

Female.—Body brownish black, entirely clothed with close silvery buff pubescence with a silky sheen, with only punctures on bases of elytra showing black; antennæ and legs clothed with paler grayish white, with apical third or so, each, of third and following antennal segments dark brown.

Head broader than prothorax at anterior margin, fairly plane in front; mandibles long; frons a little wider than high, and slightly broader below than above; vertex somewhat deeply concave, antennal supports forming an angle of about 95 degrees; occiput smooth and evenly convex except for a fine median groove and a concavity between superior eye-lobes; inferior eye-lobes deeper than wide, broadest above middle. Antennæ twice as long as body, tapering; scape unevenly thickened, impunctate, five-eighths as long as third segment; fourth segment a little longer than scape; fifth and following slightly shorter. Prothorax, including tubercles, nearly one-half again as long as broad, broader at base than at apex; a broad-based, nipple-like tubercle above middle of each side; disc slightly concave in middle, punctured on each side, subtransversely grooved near base and sinuately near apex. Elytra gradually narrowed and rounded apically; surface distinctly punctured on

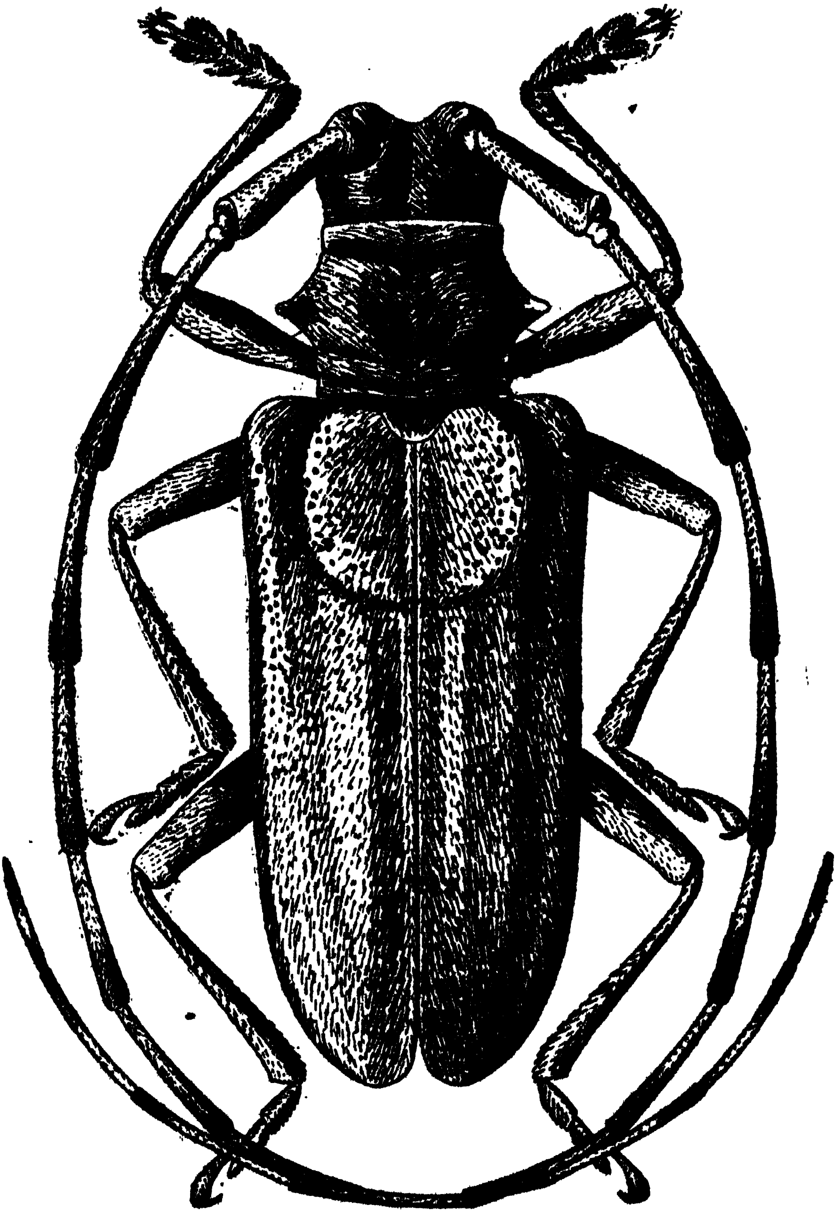

FIG. 2. *Dihamus permutans okinawanus* subsp. nov.

basal halves, asperately so near bases. Ventral surfaces and legs without distinct punctures. Length 27 millimeters; breadth 9.5

Holotype.—Female (Calif. Acad. Sci.), Okinawa and central Ryukyu Islands, June 27, 1917. Kindly presented to the writer by Mr. H. Yashiro of the Okinawa Sugar Experiment Station, near Naha, in 1932.

Differs from typical *permutans* (Pascœ) from China as follows; pubescence much paler, of a silvery instead of a deep golden hue, and arranged so as to reflect the light in smaller patches with lesser contrasts; also prothorax shorter and more strongly tuberculate, elytra with basal asperate punctures smaller and more numerous and punctures on central portions larger and more numerous. Differs from *D. permutans paucipunctatus* Gressitt as follows; prothorax broader, with smaller and more numerous punctures, dorsal surfaces with more even and paler, more silvery buff pubescence, and antennæ with more whitish pubescence.

46. DIHAMMUS PERMUTANS PAUCIPUNCTATUS Gressitt

Dihammus permutans subsp. *paucipunctatus* Gressitt, Philip. Jour. Sci. 65 (1938) 157 (Formosa); (type in U.S. Nat. Mus.).

Dihammus permutans Mitono, Cat. Col. Jap. 8 (1940) 145 (Iriomote, Ishigaki).

The specimens in the Taiwan Agric. Res. Inst. collection, on which Mitono's records are based, seem to agree more closely with Formosan specimens than with mainland Chinese or the preceding subspecies described from Okinawa.

Ishigaki and Iriomote; also Formosa.

47. DIHAMMUS SUBLUSCUS MACULIHUMERUS Matsushita

Dihammus maculihumerus Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 328, *pl. 4, fig. 3* (Formosa); (type in Hokkaido Univ.).

Dihammus subluscus maculihumerus Mitono, Cat. Col. Jap. 8 (1940) 146 (Ishigaki).

Ishigaki; also Formosa.

48. ANOPLOPHORA (s. str.) GLABRIPENNIS (Motschulsky)

Cerosterna glabripennis Motschulsky, Etudes Ent. 2 (1858) 48 (Pekin).

Melanauster glabripennis Kano, Rep. First Sc. Exped. Manchoukuo 5 10 (1936) 10, *pl. 1, fig. 1* (Jehol).

One (C.A.S.) was taken on Ishigaki by J. C. Thompson in 1911. Previously unrecorded.

Ishigaki; also Formosa, Japan (Honshu), Korea, and China.

49. ANOPLOPHORA (s. str.) MACULARIA (Thomson)

Calloplophora macularia Thomson, Syst. Ceramb. (1865) 553 ("N. China").

Melanauster chinensis var. *macularius* Bates Ann. Mag. Nat. Hist. (4) 12 (1873) 311 (Japan).

Melanauster chinensis var. *macularius* Bates, Ann. Mag. Nat. Hist. (1927) 8 (Okinawa); Miwa, Mushi 8 (1935) 38 (Yonakuni); Mitono, Cat. Col. Jap. 8 (1940) 148 (Amami-Oshima).

Some from Amami-Oshima taken to be this form were seen in the Nase Experiment Station collection in 1932.

Host.—*Citrus*, etc.

Amami-Oshima, Okinawa, and Yonakuni; also Japan, Korea, and Formosa.

50. ANOPLOPHORA (s. str.) MACULARIA OSHIMANA (Fairmaire)

Melanauster oshimanus Fairmaire, Bull. Soc. Ent. France (1895) 390 (Amami-Oshima); Miwa, Trans. Kansai Ent. Soc. 6 (1935) 24, *pl. 3, fig. 3*.

This form was synonymized with *macularia* by Breuning. Whether it is the same as *macularia* or, if different, whether both forms occur in the Ryukyu Islands, requires further study.

One (C.A.S.) Nase, Amami-Oshima, July 1932, Gressitt.

Host.—*Citrus*.

Amami-Oshima. Endemic.

51. BLEPEPHAEUS DECOLORATUS (Schwarzer)

Cereopsius decolorata Schwarzer, Ent. Blätt. 21 (1935) 59 (Formosa); Miwa, Trans, Nat. Hist. Soc. Formosa 23 (1933) 12 (Iriomote); Mushi 8 (1935) 38 (Yonakuni).

Two (C.A.S.) Naha, Okinawa, Aug. 1931, H. Yashiro; Iriomote, August 1934, Gressitt.

Okinawa, Iriomote, and Yonakuni; also Formosa.

Tribe BATOCERINI

52. APRIONA GERMARI (Hope)

Lamia germari Hope, in Gray, Zool. Misc. (1831) 28 (Sylhet).

Apriona plicicollis Motschulsky, Etudes Ent. 2 (1858) 48 (N. China).

Apriona rugicollis Chevrolat, Rev. Mag. Zool. (2) 4 (1852) 418 (China).

Apriona rugicollis Yashiro, Okinawa Sugar Exp. Sta. Bull. 1 (1927) 7 (Okinawa); Sakaguchi, 1927, Prov. Lists Ins. Okinawa.

Apriona germari Mitono, Cat. Col. Jap. 8 (1940) 155 (Amami-Oshima).

One (C.A.S.) Nago, Okinawa, July 1932, Gressitt; specimens seen at Nase Experiment Station, Amami-Oshima, in 1932.

Host.—*Morus*.

Amami-Oshima, Okinawa; also Formosa, Korea, China, and Assam.

Tribe MESOSINI

53. MESOSA (SAIMIA) CERVINOPICTA (Fairmaire)

Pachyosa cervinopicta Fairmaire, Bull. Soc. Ent. France (1897) 71 (Ishigaki); Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 12 (Iriomote); Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 344 (Miyako); Miwa, Mushi 8 (1935) 38 (Yonakuni).

One (Lingnan) from Okinawa was presented to the writer by H. Yashiro in 1932; others (C.A.S.) Iriomote, July 1932 and August 1934, Gressitt.

Okinawa, Miyako, Ishigaki, Iriomote and Yonakuni. Endemic.

54. MESOSA (SAIMIA) PICTIPES Gressitt

Mesosa pictipes Gressitt, Kontyu 11 (1937) 323, *fig. 4* (Okinawa); (type in C.A.S.).

Mesosa longipennis pictipes Mitono, Cat. Col. Jap. 8 (1940) 158.

One specimen from Amami-Oshima, probably of this species, was seen in the Nase Agriculture Experiment Station in 1932. This belongs to a different subgenus from *longipennis*.

Okinawa (Nago); Amami-Oshima (?). Endemic.

Tribe RHODOPINI

55. RHODOPIS OKINAWENSIS Matsushita

Rhodopis okinawensis Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 350, *pl. 4, fig. 11* (Okinawa); (type in Hokkaido Univ.).

Okinawa. Endemic.

Tribe DORCASCHEMATINI

56. OLENECAMPTUS BILOBUS NIPPONENSIS Dillon et Dillon

"*Olenecamptus sexpustulatus* Matsumura", Sakaguchi, 1927, Prov. List Ins. Okinawa nom. nud.

Olenecamptus bilobus Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 12 (Iriomote).

Olenecamptus bilobus nipponensis Dillon et Dillon, Trans. Amer. Ent. Soc. 73 (1948) 229, *pl. 10, fig. 8* (Ishigaki, Iriomote, Okinawa, "Japan"); (type in C.A.S.).

The specimens I collected on Iriomote and was credited to Okinawa formed part of the type material described by the Dillons.

Host.—*Ficus.*

Okinawa, Ishigaki, and Iriomote. The Japan record is to be questioned. The species as a whole is distributed from Madagascar to Australia and Micronesia, including S. China and Formosa.

57. OLENECAMPTUS OCTOPUSTULATUS FORMOSANUS Pic

Olenecamptus formosanus Pic, Mat. Longic. 9, 1 (1914) 19 (Formosa); Kamiya and Adachi, Nat. Color Col. Icon. (1933) *pl. 42, fig. 14*; Mitono, Cat. Col. Jap. 8 (1940) 165 (Tokunoshima).

One (Taiwan Agric. Res. Inst.) Amami-Oshima, March.
Host.—Morus.

Amami-Oshima, Tokunoshima; also Formosa and Yakushima. Ryukyu specimens were not studied by the Dillons.

Tribe XENOLEINI

58. XENOLEA TOMENTOSA ASIATICA (Pic)

Aeschopalea asiatica Pic, Exchange (40) 41 (1925) 16 (Tonkin).

One (C. A. S.) was taken on Ishigaki, July 1934, by H. Yashiro; two (Taiwan Agric. Res. Inst.) Iriomote, June 1932, S. Hirayama. New to the Ryukyus. [One (Taiwan Agric. Res. Inst.) Mt. Wakasugi, Kyushu, Aug. 4, 1934, T. Shirouzu. New to Japan.]

Ishigaki and Iriomote; also Formosa, Japan, S. China, and Tonkin.

Tribe BUMETOPINI

59. BUMETOPIA OSCITANS PLAGIATA Schwarzer

Bumetopia oscitans var. *plagiata* Schwarzer, Ent. Blätt. 21 (1925) 64 (Formosa); Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 355 (Ishigaki).

One from Okinawa, possibly of this form or the next, was seen at the Sugar Experiment Station, near Naha, in 1932.

Ishigaki; Okinawa (?); also Formosa.

60. BUMETOPIA OSHIMANA Breuning

Bumetopia oshimana Breuning, Fetscher. E. Strand 5 (1939) 162 (Amami-Oshima); (type in Brit. Mus.).

? *Bumetopia oscitans* var. *plagiata*, Mitono, Cat. Col. Jap 8 (1940) 168 (part: Amami-Oshima).

Amami-Oshima; (Okinawa?=see preceding species). Endemic.

Tribe NIPHONINI

61. ABRYNA COENOSA Newman

Abryna cœnosa Newman, Entomologist 1 (1842) 289 ("Manila"); Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 12 (Iriomote); Trans. Kansai Ent. Soc. 6 (1935) 25, *pl. 3 fig. 6* (Amami-Oshima, Yonakuni); Mitono, Cat. Col. Jap. 8 (1940) 169 (Ishigaki).

Abryna obscura Schwarzer, Ent. Blätt 21 (1925) 65 Formosa).

Abryna Cœnosa subsp. *loochooana* Matsushita, Ins. Matsumurana 7 (1933) 108 (Okinawa).

Some (C.A.S.) Nago, Okinawa, July 1932, Gressitt.

Amami-Oshima, Okinawa, Ishigaki, Iriomote, and Yonakuni; also Formosa, Botel-Tobago, and the Philippines.

62. NIPHONA FURCATA (Bates)

Aelara furcata Bates, Ann. Mag. Nat. Hist. (4) 12 (1873) 314 (Japan, Formosa); (type in Brit. Mus.).

Niphona furcata Esaki, Hori and Yasumatsu, Ins. Jap. Ill. Icon. (1938) *pl. 136, fig. 530:1;* Mitono, Cat. Col. Jap. 8 (1940) 170 (Amami-Oshima, Okinawa).

Hosts.—Bamboos.

Amami-Oshima and Okinawa; also Japan, Formosa, and E. China.

63. NIPHONA YANOI Matsushita

Niphona furcata Miwa (*nec* Bates), Trans. Nat. Hist. Soc. Formosa *23* (1933) 12 (Iriomote).

Niphona yanoi Mats., op. cit. 24 (1934) 240 (Formosa).

Iriomote; also Formosa.

64. PTEROLOPHIA ANNULATA (Chevrolat)

Coptops annulata Chevrolat, Rev. Zool. 8 (1845) 99 (Macao).

Praonetha Bowringii Pascœ, Trans. Ent. Soc. London (3) 3 (1865) 170, note (Hong Kong).

Pterolophia scutellata Schwarzer, Ent. Blätt. 21 (1925) 66 (Formosa); Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 13 (Iriomote).

Pterolophia bowringii Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 360 (Okinawa).

Pterolophia annulata Mitono, Cat. Col. Jap. 8 (1940) 171 (amami-Oshima).

One (C.A.S.) Nago, Okinawa, July 4, 1932, Gressitt; one, Nase, Amami-Oshima, Y. Maki.

Amami-Oshima, Okinawa, Iriomote; also Japan, Formosa, S. China, and Burma.

65. PTEROLOPHIA CAENOSA Matsushita

Pterolophia cænosa Matsushita, Ins. Mats. 7 (1933) 707, *fig. 5* (Okinawa; Formosa); (type in Hokkaido Univ.).

Okinawa, also Formosa.

66. PTEROLOPHIA LATEFASCIA Schwarzer

Pterolophia latefascia Schwarzer, Ent. Blätt. 21 (1925) 65 (Formosa); Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 13 (Iriomote).

Pterolophia fainanensis Pic, Mel. Exot. Ent. 45 (1926) 32 (Formosa).

Iriomote; also Formosa.

67. PTEROLOPHIA LOOCHOOANA Matsushita

Pterolophia loochooana Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 361 (Okinawa); (type in Hokkaido Univ.).

Okinawa. Endemic.

68. PTEROLOPHIA OBSCURA Schwarzer

Pterolophia obscura Schwarzer, Ent. Blätt. 21 (1925) 66 (Formosa); Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 12 (Iriomote).

Iriomote, also Formosa.

Tribe APOMECYNINI

69. APOMECYNA MACULATICOLLIS Pic

Apomecyna maculaticollis Pic, Mel. Exot. Ent. **28** (1918) 6 (Formosa); Matsushita, Jour. Fac. Agric. Hokkaido Univ. **34** (1933) 367 (Okinawa); Mitono, Cat. Col. Jap. **8** (1940) 177 (Amami-Oshima, Ishigaki).

? *Apomecyna naevia* Miwa, Trans. Nat. Hist. Soc. Formosa **23** (1933) 12 (Iriomote).

Amami-Oshima, Okinawa, Ishigaki, and Iriomote; also Formosa, Japan and Korea.

Tribe PTERICOPTINI

70. SYBRA BACULINA Bates

Sybra baculina Bates, Proc. Zool. Soc. London (1866) 352 (Formosa); (type in Brit. Mus.); Miwa, Trans. Nat. Hist. Soc. Formosa **23** (1933) 13 (Iriomote); Mitono, Cat. Col. Jap. **8** (1940) 181 (Amami-Oshima).

One (C. A. S.) Iriomote, August 20, 1934, Gressitt. Amami-Oshima, and Iriomote; also Formosa and Botel-Tobago (?).

71. SYBRA LOOCHOOANA Breuning

Sybra loochooana Breun., Festsch. E. Strand **5** (1939) 263 ("Riukiu Archipelago: Loochoo"); (type in Brit. Mus.).

Ryukyu Archipelago, most likely Okinawa. Endemic.

72. SYBRA ORDINATA Bates

Sybra ordinata Bates Ann. Mag. Nat. Hist. (4) **12** (1873) 318 (Japan); (type in Brit. Mus.); Matsushita, Jour. Fac. Agric. Hokkaido Univ. **34** (1933) 373 (Okinawa).

? *Sydonia costata* Miwa (*nec* Matsushita), Trans. Kansai Ent. Soc. **6** (1935) 25, *pl. 4, fig. 3* (Amami-Oshma); Mitono, Cat. Col. Jap. **8** (1940) 185 (Iriomote).

Several (Taiwan Agric. Res. Inst.) Iriomote, May–June 1932, S. Hirayama; (C. A. S.) Ishigaki, August 27, 1934, Gressitt. Amami-Oshima, Okinawa, Ishigaki and Iriomote; also Japan.

73. SYBRA PUNCTATOSTRIATA Bates

Sybra punctatostriata Bates, Proc. Zool. Soc. London (1866) 351 (Formosa); (type in Brit. Mus.); Mitono, Cat. Col. Jap. **8** (1940) 182 (Amami-Oshima, Ishigaki).

Homonoxa gossipi Shiraki, Special Bull. Agric. Exp. Sta. Formosa **5** (1912) 219, *pl. 11, figs. 1–4* (Formosa).

Sybra alternans Miwa (*nec* Wiedemann), Trans. Nat. Hist. Soc. Formosa **23** (1933) 13 (Iriomote).

One (C. A. S.) Shuri, Okinawa, June 4, 1914, J. E. A. Lewis. *Host.—Gossypium.*

Amami-Oshima, Okinawa, Ishigaki, and Iriomote; also Formosa, Kyushu, and E. China.

Tribe ESTOLINI

74. DIBOMA COSTATA (Matsushita)

Sydonia costata Matsushita, Jour. Fac. Agric. Hokkaido Univ. 31 (1938) 379, *pl. 5, fig. 1* (Okinawa); (type in Hokkaido Univ.).
Donysia costata Gressitt, Philip. Jour. Sci. 72 (1940) 179 (Hainan).
Diboma loochooana Breun., Folia Zool.-Hydrobiol. 10 (1940) 78 (Loochoo Is.); (type in Brit. Mus.); new synonym.

Some (C. A. S.) Makabe, Okinawa, March 1918, H. Yashiro; Nago, Okinawa, July 4, 1932, Gressitt.

Okinawa (Makabe, Nago); also Hainan I.

75. DOIUS MERIDIANUS Matsushita

Doius meridianus Matsushita Jour, Fac. Agric. Hokkaido Univ. 34 (1933) 380, *pl. 4, fig. 8* (Formosa); (type in Hokkaido Univ.); Miwa Trans. Kansai Ent. Soc. 6 (1935) 25, *pl. 3, fig. 10* (Amami-Oshima); Mitono, Cat. Col. Jap. 8 (1940) 186 (Ishigaki).

Amami-Oshima (Gusuku), Ishigaki; also Formosa.

Tribe HIPPOPSINI

76. POTHYNE ALBOLINEATA Matsushita

Pothyne albolineata Matsushita Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 383 (Formosa); (type in Hokkaido Univ.).
Pothyne silacea Miwa (*nec* Pascoe), Trans. Nat. Hist. Soc. Formosa 23 (1933) 13 (Iriomote).

Some (Taiwan Agric. Res. Inst.) Iriomote, May–June 1932, S. Hirayama. Previously unrecorded from the Ryukus. It is possible that part or all of the specimens referred to, and the citations of Mitono and Miwa, under *P. formosana* Schwarzer below, may pertain to this species, as they were studied at an earlier date, and the foregoing specimens taken by Hirayama are from the same material reported upon by Miwa in 1933.

Iriomote; also Formosa.

77. POTHYNE FORMOSANA Schwarzer

Pothyne formosana Schwarzer, Ent. Blätt. 21 (1925) 146 (Formosa); Mitono, Cat. Col. Jap. 8 (1940) 188 (Miyako).
Pothyne silacea Miwa (*nec* Pascoe), Trans. Nat. Hist. Soc. Formosa 23 (1933) 13 (Iriomote).

Some (C. A. S.) Iriomote, August 1934, Gressitt, were earlier identified as this species, but may actually belong to the preceding. Miyako and Iriomote; also Formosa.

78. POTHYNE LITURATA Matsushita

Pothyne liturata Matsushita Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 384 (Okinawa); (type in Hokkaido Univ.); Mitono, Cat. Col. Jap. 8 (1940) 188 (Amami-Oshima, Iriomote).

Amami-Oshima, Okinawa, and Iriomote. Endemic.

79. POTHYNE VARIEGATA

Pothyne variegata Thomson, Syst. Ceramb. (1864) 97 (Malasia). *Neopothyne variegata* Matsushita, Trans. Sapporo Nat. Hist. Soc. 12 (1931) 46, *fig. 3* (Formosa); syn., hom.; (type in Hokkaido Univ.); Mitono, Cat. Col. Jap. 8 (1940) 189 (Ishigaki).

One (C. A. S.) Nase, Amami-Oshima, 1931, Y. Maki.

Amami-Oshima and Ishigaki; also Formosa, Siam, Burma, and Assam.

Tribe ACANTHOCININI

80. LAGOCHLIRUS OBSOLETUS Thomson

Lagocheirus obsoletus Thomson, Classif. Ceramb. (1860) 10 (Mexico); Aurivillius, Col. Cat. 74 (1923) 392 (Loo Choo Is.).

"Loo Choo Is." I have seen no Ryukyu specimens or recent records. The presence in the archipelago of this species, known from Central America and Hawaii, may be questioned.

81. MIAENIA BREVICOLLIS sp. nov. Fig. 3.

Female.—Slender and dorso-ventrally compressed; slightly broadened posteriorly. Body reddish brown to dull chocolate brown, darker on head and prothorax, the latter with anterior and posterior constricted portions dull orange testaceous; antennæ grayish brown; ventral surfaces dull reddish brown; tarsi brownish testaceous; surfaces clothed with thin pale grayish buff pubescence, with pronotal disc more or less glabrous and elytra with a vague basal glabrous spot on disc of each, a transverse spot on side of each at middle, and two vague common spots on suture, roughly at beginning and end of middle third, respectively, besides some irregular small glabrous dots; ventral surfaces and legs more thinly clothed.

Head practically as broad as anterior end of prothorax, frontal outline suboblong, wider than deep; frons one-half again as broad as high, wider below, finely punctured and convex; vertex broad, very shallowly concave; occiput closely punctulate; eyes with inferior lobes rounded and slightly deeper than their distances from genal angles. Antennæ extremely slender, one-half again as long as body; scape fusiform-cylindrical, slightly constricted before apex, three-fourths as long as third segment; fourth not quite as long as third, distinctly shorter than fifth and sixth combined; following segments gradually shorter.

Prothorax one-third broader than long, cylindrical anteriorly, constricted in basal portion, armed with a minute, slender, acute tooth, at beginning of posterior constriction, pointing obliquely backward; surface moderately convex, closely and finely punctulate. Elytra narrow; slightly broadened to beginning of apical third; apices broadly rounded; surface of each impressed with about ten rows of fine but close punctures above, and less regularly punctured at side; disc feebly swollen near base. Ventral surfaces closely punctured at sides. Legs slender; first hind tarsal segment not quite as long as following

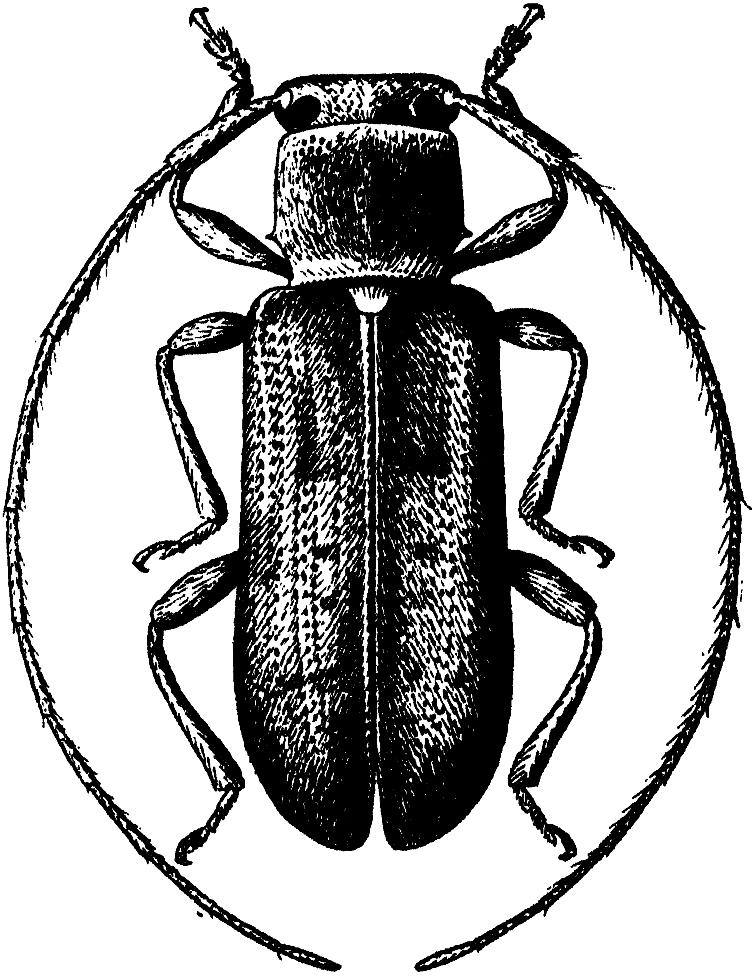

FIG. 8. *Miaenia brevicollis* sp. nov.

two combined and distinctly shorter than last segment. Length 2.9 millimeters; breadth 0.95.

Holotype.—Female (Calif. Acad. Sci.), Iriomote (southwest side), Yaeyama Subgroup, Sakishima Group, Southern Ryukyu Islands, August 19, 1934, J. L. Gressitt.

Differs from *M. subfasciata* Schwarzer in being much smaller, more slender, and without a distinct band on elytra.

82. MIAENIA SAKISHIMANA sp. nov. Fig. 4.

Female.—Moderately elongate, subparallel-sided, slightly compressed dorsally. Body reddish brown, marked with dark brown on apical portions of elytra and posterior borders of abdominal segments; surfaces clothed with whitish gray and yellowish pubescence as follows: head sparsely clothed with gray in front and with yellow mixed with gray on vertex occiput and genæ, antennæ very thinly clothed with pale hairs, a little more distinctly so at bases of third and following segments; prothorax largely marked by spots of yellowish pubescence interspersed with gray pubescence broken by small glabrous spots, central portion of disc glabrous except for a median gray stripe and an elongate oval yellow spot on each side behind middle; elytra each subglabrous an basal portion of disc with a few yellow spots around humerus and on side, an oblique band of yellow from suture just before middle to external margin at end of third quarter, separated by a wider glabrous band from a similar, less oblique irregular band of gray and yellow; between this and an oblique yellow and gray band from suture just behind middle to external margin at beginning of apical quarter the surface is gray with glabrous spots, and the apical portion is gray mottled with yellow; ventral surfaces almost entirely clothed with grayish white and marked with a few orange-yellow spots on sides of thorax; legs sparsely clothed with gray.

Head practically as broad as anterior portion of prothorax; outline rounded squarish in front; frons a little wider than deep, broadest at middle; vertex broad and feebly concave; occiput plane; surfaces finely punctured; eyes deeply emarginate, with inferior lobes nearly round and superior lobes rather close. Antennæ very slender, one-fourth longer than body; scape long, conico-cylindrical, feebly curved; fully as long as third segment; fourth nearly as long as third, subequal to fifth and sixth combined; remaining segments gradually shorter. Prothorax one-fourth again as broad as long,

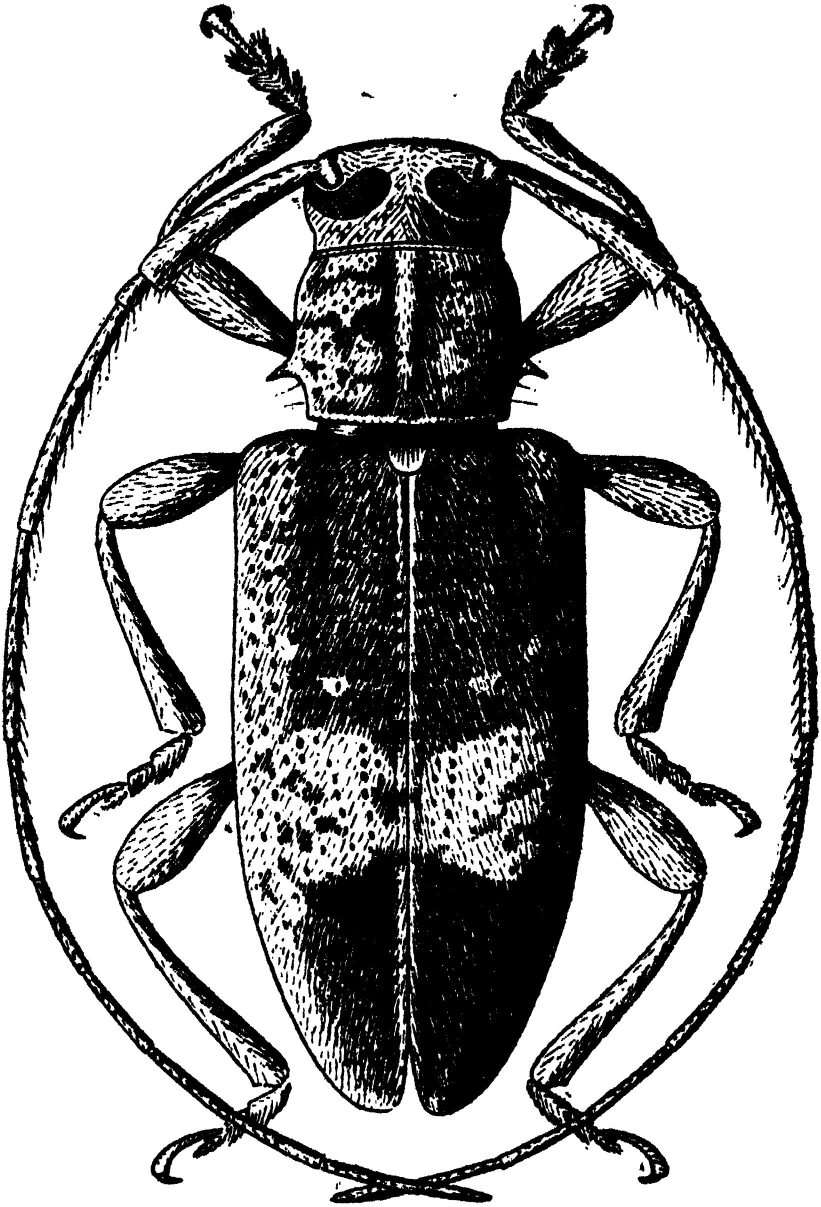

FIG. 4. *Miaenia sakishimana* sp. nov.

excluding lateral spines, which are slender, acute, arising behind middle of each side and directed obliquely backwards; basal portion slightly constricted; disc feebly convex, closely and finely punctured. Elytra narrowed in posterior third and rounded at apices; surfaces more or less seriate-punctate, the punctures close and coarse basally. Sides of metathorax deeply punctured. Length 6 millimeters; breadth 1.95 millimeters.

Male.—Antennæ one-half again as long as body. Color more grayish, with smaller glabrous areas and without distinct oblique yellow bands on elytra. Length 4.8 millimeters; breadth 1.5.

Holotype.—Female (U. S. N. M.) Iriomote Island (southwest side), Yaeyama Subgroup, Sakishima Group, southern Ryukyu, August 20, 1934, J. L. Gressitt; allotype, male (Calif. Acad. Sci.) Ishigaki (Yaeyama) I., Sakishima Group, July 29, 1939, collected by Mr. H. Yashiro and kindly presented to the writer in 1934.

Differs from *Miaenia subfasciata* Schwarzer in being more elongate and paler with a pale, instead of dark, postmedian band. Differs from *M. granulicollis* Gressitt in being narrower and in having the scape and third antennal segment distinctly longer and the prothorax shorter, punctulate instead of granulate and with more slender lateral spines.

Key to the Ryukyu and Formosan species of Miaenia

1. Prothorax punctulate 2
   Prothorax granulate; length 5 to 5.5 millimeters ....*granulicollis* Gress.
2. Elytra with a more or less distinct transverse band; length over 4.5 millimeters 3
   Elytra without a more or less distinct transverse band; length 2.9 millimeters ....*brevicollis* Gress.
3. Elytra with a dark band behind middle; body fairly broad, more than one-third as broad as long. ....*subfasciata* Schw.
   Elytra with a pale band behind middle; body narrow, less than one-third as broad as long ....*sakishimana Gress.*

Tribe GLENEINI

83. GLENEA (s. str.) CHLOROSPILA Gahan

Glenea chlorospila Gahan, Ann. Mag. Nat. Hist. (6) **19** (1897) 488 (Amami-Oshima); (type in Brit. Mus.); Matsushita, Jour. Fac. Agric. Hokkaido Univ. **34** (1933) 411 (Okinawa; Formosa).

Some (C. A. S.) Gusuku, Amami-Oshima, July 1932, Gressitt.

Amami-Oshima and Okinawa; also Formosa, Yakushima and Shikoku. *G. hachijonis* Matsumura et Matsushita, 1933, from Hachijo I., south of Tokyo Bay, has been synonymized with this species.

84. GLENEA (s. str.) IWASAKII Kano

Glenea iwasakii Kano, Kontyu 7 (1933) 139 (Ishigaki); Mitono, Cat. Col. Jap. 8 (1940) 208 (Amami-Oshima; Iriomote).
Glenea stolata Matsumura et Matsushita, in Matsushita, Jour. Fac. Agric. Hokkaido Univ. 34 (1933) 413, *pl. 3, fig. 7* (Ishigaki); (type in Hokkaido Univ.).

One (C.A.S.) Ishigaki.

Amami-Oshima, Ishigaki, and Iriomote. Endemic.

85. GLENEA (s. str.) LINEOSA Aurivillius

Glenea lineata Gahan, (nec Fabr.), Ann. Mag. Nat. Hist. (6) 19 (1897) 483 (Amami-Oshima); (type in Brit. Mus.).
Glenea lineosa Aurivillius, Col. Cat. 74 (1923) 499 (new name for *lineata* Gahan); Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 13 (Iriomote).
Glenea formosana Schwarzer, Ent. Blätt. 21 (1924) 150 (Formosa);

Some (C.A.S.) Gusuku, Amami-Oshima, July 1932 and Iriomote, August 1934, Gressitt; Chizuka, Okinawa, July-Sept., 1945, G. E. Bohart.

Amami-Oshima, Okinawa and Iriomote; also Formosa.

86. GLENEA (s. str.) LINEOSA SAUTERI Schwarzer

Glenea sauteri Schwarzer, Ent. Blätt. 21 (1925) 150 (Formosa); Miwa, Trans. Nat. Hist. Soc. Formosa 23 (1933) 13 (Iriomote).
Glenea lineata Sakaguchi, 1927, Prov. Lists Ins. Okinawa.
Glenea lineosa sauteri Mitono, Cat. Col. Jap. 8 (1940) 209.

One from Okinawa was seen in the Naha Sugar Experiment Station collection in 1932.

Okinawa and Iriomote; also Formosa.

Tribe PHYTOECIINI

87. OBEREA BICOLORIPES ISIGAKIANA Matsushita

Oberea bicoloripes var. *isigakiana* Matsushita, Ins. Matsumurana 15 (1941) 158 (Ishigaki).

Ishigaki I. Endemic. The nymotypic form is from Formosa

88. OBEREA GRISEOPENNIS (Schwarzer)

Oberea griseopennis Schwarzer, Ent. Blätt. 21 (1925) 154 (Formosa); Mitono, Cat. Col. Jap. 8 (1940) 214 (Amami-Oshima, Okinawa).

One (C.A.S.) Nase, Amami-Oshima, July 1932, Gressitt.

Host.—Cinnamomum camphora.

Amami-Oshima and Okinawa; also Formosa and Yakushima.

89. OBEREA JAPONICA (Thunberg)

Saperda japonica Thunberg, Mus. Nat. Acad. Upsal. 4 (1787) 57, note 10 (*non* fig.) (Japan).
Oberea japonica Esaki, Hori and Yasumatsu, Ins. Jap. Ill. Icon. (1938) *pl. 136, fig. 523:2.*

Oberia niponensis Bates, Jour. Linn. Soc. London 18 (1884) 260 (Japan).

One specimen from Amani-Oshima presumed to be of this species was seen in 1932 in the Nase Agriculture Experiment Station, collected by Y. Maki.

Amami-Oshima; also Japan, Korea and Manchuria.

APPENDIX

I

I have in my notes a questionable record for the following species. Its presence in the Ryukyu archipelago must be verified before it is definitely added to the list.

ALOTRAEUS (s. str.) sphaerioninus Bates (Subfamily Cerambycinae: Tribe Phoracanthini)

Allotraeus sphaerioninus Bates, Ent. Monthly Mag. 14 (1877) 37 (Japan); Kamiya and Adachi, Nat. Color Col. Icon. (1933) *pl. 42, fig. 11.*

Questionably from Okinawa. Known from Japan; questionably from Formosa.

II

Below are listed the Cerambycidae known from Yakushima, the forested volcanic island nearly two thousand meters in height, located between Kyushu and the Ryukyu chain, but closer to the former than to Amami-Oshima. Those followed by collection data are represented in the Taiwan Agriculture Research Institute collection by specimens collected by K. Nomura in June 1936, except for one taken by the late Mr. J. E. A. Lewis. The species preceded by a dagger (†) have apparently not previously been rcorded from Yakushima. Only 16 of the 42 species listed below are known from the Ryukyu chain. These not found in the Ryukyus are asterisked. About 150 species are known from Kyushu which are not known from the Ryukyus.

* **Prionus insularis** Motschulsky, 1857 (Anbo and Onoma-anbo, June 1936, K. Nomura)
* **Psephactus remiger** Harold, 1879
Spondylis buprestoides (Linnaeus), 1758
* † **Arhopalus (Megasemum) quadricostulatus** (Kraatz), 1879 (Onoma-anbo, June 1936, K. Nomura).
* **Distenia gracilis** (Blessig), 1872
* **Anoplodera (Anoploderomorpha) excavata** (Bates), 1884

- * **Leptura (s. str.) ochraceofasciata (Motschulsky), 1861**
- * **Leptura (s. str.) tenuicornis (Motschulsky), 1861**
- * **Leptura s. str.) yakushimana (Tamanuki), 1942, new combination strangalia.**
- * **Strangalia dulcis** Bates, 1884
- * **Pseudaeolesthes chrysothrix** (Bates), 1873
- **Allotraeus** (s. str.) **sphaerioninus** Bates, 1877
- **Stenygrinum quadrinotatum** Bates, 1873
- **Neosalpinia lepturoides** Matsushita, 1933 (Chishinsan—Jurinban, June 1936, Nomura).
- * **Thranius variegatus** Bates, 1873 (Kurifu, June 1936, Nomura).
- **Molorchus takeuchii** Ohbayashi, 1937
- * **Leontium viride** Thomson, 1864
- * **Rosalia** (s. str.) **batesi** Harold, 1877
- * **Xylotrechus emaciatus** Bates, 1884
- * **Chlorophorus motschulskyi** (Ganglbauer), 1886
- **Chlorophorus muscosus** (Bates), 1873
- * **Chlorophorus notabilis** (Pascoe), 1862
- * **Chlorophorus quinquefasciatus** (Castelnau and Gory), 1841
- * **Aglaophis colobotheoides** Bates, 1884
- * **Purpuricenus (Sternoplistes) spectabilis** Motschulsky, 1857
- **Psacothea hilaris** (Pascoe), 1857
- * **Monochamus fascioguttatus** Gressitt, 1938
- * **Monochamus subfasciatus** Bates, 1873
- * **Dihammus fraudator** (Bates), 1873 ("*D. cervinus*")
- **Dihammus luxuriosus** (Bates), 1873
- **Anoplophora** (s. str.) **macularia** (Thomson), 1865
- * **Eupromus ruber** (Dalman), 1817 (Kosugiya and Anbo, June 1936, Nomura).
- * **Mesosa (Aphelocnemia) longipennis** Bates, 1873
- **Mesosa (Saimia) pictipes** Gressitt, 1937
- * **Rhodopis lewisi** Bates, 1873
- **Olenecamptus octopustulatus formosanus** Pic, 1914 (Anbo, June 1936, Nomura).
- * **Abryna coenosa** Newman, 1842
- † **Pterolophia annulata** (Chevrolat) (Taken by the late Mr. John E. A. Lewis).
- **Sybra baculina** Bates, 1866
- **Glenea** (s. str.) **chlorospila** Gahan, 1897
- * **Glenea** (s. str.) **relicta** Pascoe, 1858
- **Oberea griseopennis** Schwarzer, 1925
- * **Epiglenea comes** Bates, 1884

III

The following species are known from Tanegashima, the long low island just east of Yakushima, off the southern tip of Kyushu:

Chlorophorus muscosus (Bates), 1873
Chlorophorus quinquefasciatus (Castelnau and Gory), 1841
Chlorophorus signaticollis (Castelnau and Gory), 1841

* †**Monochamus subfasciatus** Bates, 1873 (Taken by J. E. A. Lewis. Apparently unrecorded).

Olenecamptus octopustulatus formosanus Pic. 1914

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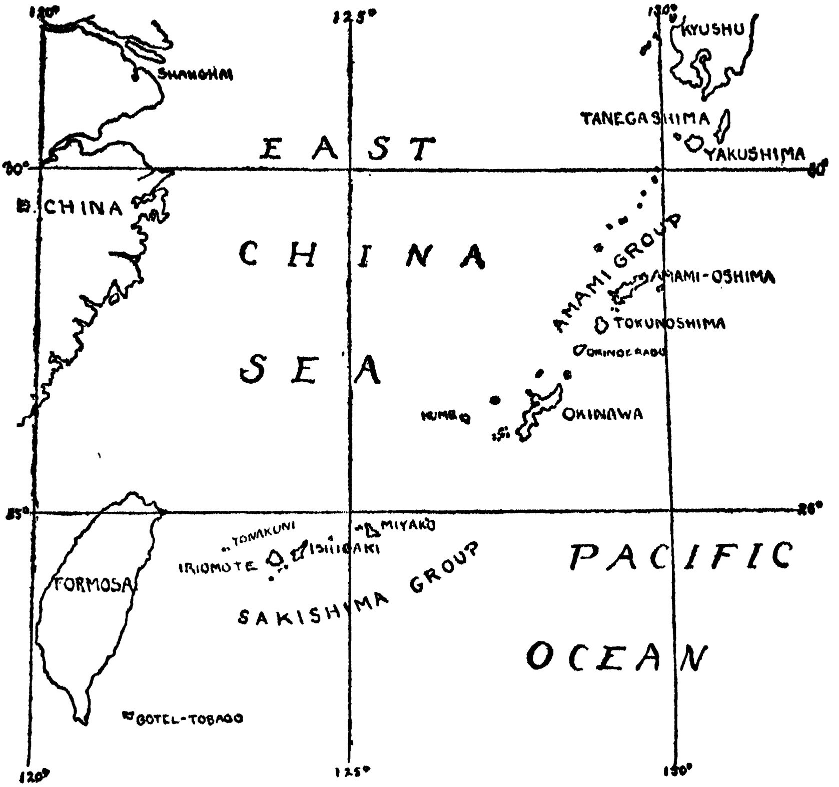

FIG. 5. The Ryukyu Islands

BOOKS

Books reviewed here were received from time to time by The Philippine Journal of Science and acknowledged in this section.

Curtman, L. J. Introduction to semi-micro qualitative chemical analysis. Rev. ed. New York, The Macmillan Co., 1950, 391p. Price ₱7.00

Introduction to Semi-micro Qualitative Chemical Analysis, by Louise J. Curtman, has introduced quite a number of new innovations into the field of qualitative analysis. Some of these new features are the adjustment of acidity prior to precipitating group 2, the use of potassium hydroxide in the separation of group 2 into copper and arsenic sub-groups, the removal of interferring anions prior to the examination of cations, and some limitation tests for acids. The use of small amounts of samples is emphasized to reduce the cost of chemicals needed and to eliminate as much as possible the volume of smoke and obnoxious fumes evolved in the processes. The use of centrifuge saves time in the separation of the precipitates from the solutions. All these new features make this book valuable as a text and as a reference.

The adoption of this book as a text, however, involves an addition of outlay as regards to equipment and space in the laboratory. Laboratories in most private schools in this country could ill afford additional equipment and even space. The advantages that could be derived therefrom, however, far outweigh such additional expenses. The procedures given in this book are very systematic.

The theoretical part of the subject matter is not neglected. The concepts of the structure of atoms and molecules, colloids, hydrolysis of salts, oxidation reduction reaction, physical and chemical equilibrium, and theory of the solution of sulphides in acids are masterly presented.

In view of the foregoing facts, this book should be a text in schools, as well as a reference for professionals.—R. R. O.

Duff, Roger. The Moa-Hunter Period of the Maori Culture. Wellington, Department of Internal Affairs, 1950, 405p.

The book, "The Moa-Hunter Period of the Maori Culture", is a valuable contribution to anthropological research in Polynesia. It tells about the Moa-Hunter and Polynesian ethnography, a remarkable narration of the evolution of human culture. It gives a vivid description of the Wairau camp, and an account of the excavations, which distinguish the Wairau site by its number of burials. The fashions and personal ornaments used by the Moa-Hunters are described. A detailed study of the Moa-Hunter adze culture with its various types of adzes, different types of fishing gears and methods, the use of nephrite or green stone which is unique in Polynesia, are given. The data are supported by well documented evidences. This is a good reference book for a professional archaeologist.—R. E. G.

Man's Physical Universe. Third edition. By Arthur T. Bawden. New York, The Macmillan Company, 1950, 822pp., illus. Price, $4.00.

From the point of view of the layman, as well as that of the scientist, this book is a very interesting reading material. It is highly informative without being too technical. It gives the reader a bird's eye-view of many branches of science and an understanding of the principles and relationships of phenomena frequently seen or observed in nature and in our daily life. This book would be useful to students contemplating specialization in any particular field of science as it gives a preview of the problems that they will face in that particular line. The writer has presented his subject from a very wide angle but sufficient enough to explore and explain scientific phenomena, inventions and problems. The accounts are written in a language which an educated layman will not find difficult to understand.

It is an excellent reference on scientific subjects in college. It could also be used by general science teachers in high schools.

—F. M. Y.

Natural Gas and Natural Gasoline. By R. L. Huntington. New York, Toronto, London, McGraw-Hill Book Co., Inc., 1950. 598pp., illus. Price, $8.00.

This book should be welcomed by engineering students who intend to study the technology of natural gas and natural gasoline. Because of the technical considerations of the various unit operations which include both physical and chemical principles involved, students will find this text to be of great help. Moreover, the economic and historical background of some of the subjects as presented by the author, will be of interest to busniessmen engaged in this particular line of endeavor.

The mathematical approach to high-pressure pipe line research is carefully discussed in Chapter 11 which can be used in solving complex problems of long distance transporting of gas through a system of pipes, pumps, etc.

In the Appendix, the reader will find valuable information such as tables, graphs, specifications, contracts, analytical testing methods that may be needed in his study and practice.

—N. F. M.

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COMPARATIVE RESISTANCE OF NATIVE WITH TWO IMPORTED BREEDS OF CHICKENS TO ASCARIDIA LINEATA (SCHNEIDER)

By LOPE M. YUTUC and DOMINADOR K. OYZON
Of the College of Veterinary Medicine, University of the Philippines

In some of the results on the investigations of resistance to helminthic infection it has been demonstrated that certain breeds or strains are naturally more resistant than others in the same species of animals. For instance, Miller (1908) observed that purebred Zebu cattle in Trinidad are more resistant to the ravages of strongyles than other breeds of cattle. In the observation of Gonzalez and Lago (1923) on swine improvement in the Islands, it was disclosed incidentally that native swine are more resistant to *Stephanurus dentatus* than did the imported and improved breeds of pigs. The first experimental evidence of breed difference in resistance to helminthic infection, however, appeared to have been demonstrated for the first time in chicken (Ackert et al., 1933; 1935). In general, the heavier breeds of birds were more resistant to *Ascaridia lineata* than the lighter breeds of birds were. Among sheep, lowland breeds such as the Border Leicester, on an overcrowded pasture, were more susceptible to the effect and more heavily parasitized than the Cheviot sheep (Cameron, 1935). In chicken, strain resistance to nematode infection has been noted in the Minorca and White Leghorn breeds (Ackert et al., 1934; 1936).

In this present investigation, report is made on the results obtained in the comparative study on the natural resistance of native chicken to the round worm, *Ascaridia lineata,* against that of two imported breeds, the White Leghorn and the New Hampshire. As far as the writers are aware, this is the first experimental investigation on innate helminthic resistance in the Islands.

MATERIALS AND METHODS

Purebred White Leghorn and New Hampshire, and native chickens were used in this study. In the first experiment, 40 native eggs were incubated at a local hatchery. Out of these eggs only 32 chicks were obtained. Along with these, twenty-six White Leghorn and 25 New Hampshire chicks were obtained as day-old chicks. Of these, only 18 natives, 12 Leghorns and 6 Hampshires reached the close of the experiment. Deaths registered due to an undiagnosed disease were 10 natives, 11 Leghorns and 16 New Hampshires. The rest died of various accidents. One native chick which died 16 days after infection was found to harbor worms. The number of worms obtained was noted and included in the computation for the mean number, but not in the computation for the mean length. The other post infection deaths which occurred mostly about a week after the infection did not show any worm on being posted.

Thinking that the New Hampshire group in the first experiment would not furnish enough data, a second experiment was performed using only native and New Hampshire chicks to supplement the deficiency. Accordingly, fifteen day-old native and 17 New Hampshire chicks were used. Of the native group, one died prior to infection and 4 after infection, including one killed by a dog. Postmortem examination of the post-infection deaths revealed no worm. Of the Hampshire group, 2 died before having been fed the ova.

The chicks were reared in a wire cage which measured 1 meter by 2 meters by 0.3 meter and provided with legs 0.6 meter high. Attached to one end of the cage was a compartment 1 meter by 0.3 meter. This was made of plywood all around except that side facing the enclosure, which was left open. Inside, two electric bulbs were placed to keep the chicks warm. On the other end of the cage was another compartment made of an empty milk box with an electric bulb used primarily for isolating weak and sick chicks.

The first batch of chicks were fed with "Centennial" chick starter mash, a U. S. commercial product, during the first week. After this was consumed, another brand, "Ful-O-Pep", was used. The latter brand of chick starter and triple duty was used for the second experiment. Sulfamethazine solution was given to both sets of chicks: to the first, at the height of the disease, when they were 8 days old; and to the second, when they were 9 days old, when one native bird died of coccidiosis.

The nematode eggs for infecting the chicks were secured from adult live worms recovered from native chickens. The method of preparing the egg culture was adopted from Ackert (1931), which is in brief as follows: The tip of the worm was excised and the internal contents pressed out into a sterile petri dish. The uteri were isolated and transferred to another sterile dish. Samples of the eggs on the enlarged portions of the uteri were examined under the microscope to determine their fertility. Those portions found to contain fertile eggs were then transferred to a final sterile dish and chopped very finely to liberate the eggs. The eggs were covered with sterile distilled water and 8 drops of 2 per cent formalin added to discourage fungus or bacterial growth. The culture was placed in the bacteriology inoculating room in which the temperature was 27 to 30 degrees centigrade which was found to be ideal. Cultures used for the first and second experiments were 27 and 30 days old, respectively.

The chicks were infected when they were 12 days old. Each was given 50 (plus or minus 5) eggs, as Ackert et al. (1931) found this number suitable for works on comparative resistance of the hosts. The dose was prepared by loosening the eggs from the bottom of the dish and placing a few drops in a small bottle containing glass beads and water. The bottle was shaken. This was found necessary in order to break up the clusters of eggs and at the same time suspending them evenly. The eggs were placed on a slide and were counted with the aid of a microscope equipped with a mechanical stage. The drop of water containing the correct number of eggs was wiped off the slide with a small piece of filter paper. This was folded and formed into a pellet and with a pair of forceps was placed in the esophagus and forced down into the crop with the fingers. The worms were allowed to develop for 3 weeks. At this time the worms had detached themselves from the intestinal mucosa and were then found free in the lumen (Ackert, 1931).

On the 21st day of parasitism, the chicks were decapitated and the worms collected in the following manner: The small intestine was excised from the rest of the organs and divided into three segments. At first, the intestine was opened by scissors and the contents were scraped into a glass receptacle; but with the use of scissors some worms were cut, so another method was devised. The tip of a syringe, filled with water, was inserted into one end of the segment and the water forced through it. The worm contents this time were received in a glass jar, transferred to a petri dish, counted and preserved in 10 per cent formalin until the time for measurement. To make sure no worms were left in the intestine, this was opened afterwards.

In measuring, the worms were pressed between two glass plates and placed in an epidiascope[1] and projected to 10 times magnification on a Manila paper screen. The image was traced with colored pencil, and from these tracings direct measurements were made with a gear of known calibration.

The criteria adopted in this study are the average number of worms and their average length for each breed of chicken.

EXPERIMENTS AND RESULTS

Experiment 1.—From 19 native chicks, including one which died and was autopsied, a total of 39 worms was collected. The range, as seen in Table 1, was zero to 6 worms. Of the 19 chicks, 5 failed to catch the infection. As shown in Table 2, the mean number for this group was 2.05 worms per bird, and the mean length of the worms, 21.41 mm. From 12 Leghorns, the range was 7 to 26 from a total of 180 worms obtained, and the mean number and mean length were 15 worms per bird and 30.54 mm., respectively. A total of 104 worms was collected from 6 Hampshires which had a range of 15 to 20. On computation, a mean number of 17.33 worms per bird and a mean length of 29.91 mm. were obtained.

TABLE 1.—*The number of worms obtained from each chicken*

Chicken number	Experiment 1			Experiment 2	
	Native	Leghorn	Hampshire	Native	Hampshire
1	0	8	16	4	18
2	2	7	20	0	11
3	3	26	17	0	9
4	1	20	19	0	8
5	3	24	15	1	10
6	2	15	17	3	7
7	2	8	....	0	13
8	0	20	....	9	12
9	0	14	....	4	23
10	1	13	....	2	17
11	4	11	....	....	9
12	0	14	....	....	6
13	6	....	....	....	8
14	3	....	....	....	14
15	5	....	....	....	9
16	1	....	....	....	....
17	1	....	....	....	....
18	0	....	....	....	....
19	5	....	....	....	....
Total	39	180	104	23	174

A difference of 12.95 was obtained between the mean number of the worms of the native and that of the Leghorn. This difference is 10.27 times its probable error. Since this difference

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[1] Thanks is extended to the personnel of the Department of Veterinary Anatomy for the use and operation of the projecting apparatus.

TABLE 2.—*A biometrical comparison of the mean numbers and lengths of Ascaridia lineata from native and foreign breeds used in this study*

Expt.	Breed	Number of host	Number of worm	Mean number of worm	Stan. dev.	Diff. of means (D)	P. E. of diff. (E)
I	Native	19	39	2.05±0.2954	1.91	12.95	1,2608
	Leghorm	12	180	15±1.2258	6.29		
	Native	19	39	2.05±0.2954	1.91	15.28	0.5905
	Hampshire	6	104	17.33±0.5114	1.86		
II	Native	10	23	2.3±0.6120	2.86	9.3	1,023
	Hampshire	15	174	11.6±0.8192	4.70		

Expt.	Breed	Ratio $\frac{D}{E}$	Mean lenght of worm	Stan. dev.	Diff. of means (D)	P. E. of diff. (E)	Ratio $\frac{D}{E}$
I	Native	10.27	21.41±0.5658	3.45	9.13	0.628	14.54
	Leghorn		30.54±0.2736	1.21			
	Native	25.87	21.41±0.5658	3.45	8.5	0.7126	11.93
	Hampshire		29.91±0.4340	1.82			
II	Native	9.09	23.06±0.4978	3.53	5.07	0.7296	6.95
	Hampshire		28.13±0.5389	1.93			

is at least four times its probable error, it doubtlessly lies beyond the limits of experimental error, and hence, is not due to chance variation. And when the mean number of worms of the native is compared to that of the Hampshire, a difference of 15.28 becomes evident. This is 25.87 times its probable error, hence significant.

On the other hand, comparison of the mean lengths of the worm of the native and Leghorn groups gave a significant difference of 9.13 mm., which is 14.54 times its probable error. Taking the difference in the mean length of the worm of the native and of the Hampshire, we get 8.5 mm. This is also significant in that it is 11.93 times its probable error.

Experiment 2.—Ten native chicks which yielded 23 worms on autopsy had a range of worm burden from zero to 9. Moreover, of this number, 4 did not show infection on postmortem examination. The mean number obtained was 2.3 worms per bird, and the mean length of the worms was 23.06 mm. Of the 15 Hampshires killed, 174 worms were collected with a range of from 6 to 23. Computation gave a mean number of 11.6 worms per bird and a mean length of 28.13 mm.

Between the mean numbers of the worms of the native and the Hampshire, one finds a significant difference of 9.3, which is 9.09 times its probable error. And their mean lengths compared gave a difference of 5.07 mm. which is 6.95 times its probable error, and hence, in both cases significant.

DISCUSSION

Results of these two experiments, as shown in Tables 1 and 2, indicate that the native chickens are more resistant to the nematode, *Ascaridia lineata,* than either of the two foreign breeds. This is based not only on the parasitic burden and the length of the worms collected but also on the high proportion of negative take in the native chicks, being 9 out of 29 birds. In the imported breeds, all 33 chicks were positive to an infection of 50 eggs per bird. The general statement that certain breeds or strains are naturally more resistant to helminthic infection than others finds an added evidence in the above results. Although limted work has been done on the genetic explanation of natural resistance, it has been shown in the work of Curtis et al. (1933), on the different strains of rats, that the production of more tumors caused by *Cysticercus fasciolaris* in some rats was due to genetic difference in the host. Furthermore, Ackert et al. (1934) attributed the difference in the resistance of two strains of Minorca chickens to a genetic factor. Again, Ackert, Pratt and Freeman (1936) produced a strain of White Leghorn which was resistant, as well as one that was susceptible, to the common round worm of poultry. Gregory et al. (1940) also obtained evidence of genetic factor operating while working on sheep infected with strongyles. In view of the above, it is likely that a genetic factor also operates in the different resistances of the birds studied in this investigation.

In Experiment 1, it would be noted that more worms on the average, were obtained from the New Hampshire than from the White Leghorn and both had practically the same average length of worms. This might be explained in part by the fact that the resistance of the New Hampshire must have been lowered by the diseases that caused the chicks to die at the start of the experiment, it having the highest percentage of mortality, being 64 per cent as compared to 42 per cent for the Leghorn and 31 per cent for the native. Besides, only 6 Hampshires were used. It is probable that with a larger number of chickens used, shorter and lesser number of worms would be obtained. This is aptly supported by the result of Experiment 2, where the mean number of worms went down to 11.6 per bird instead of 17.33 and the mean length being 28.13 mm. instead of 29.91 mm. in the Hampshire group.

Since the mean number and the mean length of worms recorded in the present investigation in the foreign breed group are decidedly greater than those reported by Ackert and his collaborators, it is not likely that tropical climate exerts a depressing effect upon the well-being of the chicken predisposing them to much heavier burden of parasitism than heretofore reported. This circumstance undoubtedly contributes to the significant difference in the degree of resistance of the two groups studied.

SUMMARY AND CONCLUSION

A study on the comparative resistance of native with two imported breeds of chicken to *Ascaridia lineata* (Schneider) is reported. On the basis of the experiments carried native chickens were found to be more resistant than both White Leghorn and New Hampshire breeds to the nematode.

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A MALARIA SURVEY AND CONTROL IN QUEZON CITY

By Antonio Ejercito and Cornelio M. Urbino
Malaria Control Section, Division of Laboratories
Department of Health

TWO PLATES

Quezon City, (lat. MN 38, long. 121 E 00.4) comprises an area of 15,600 hectares east north east of Manila. It is a rolling country with an altitude ranging from 5 m. to 110 m. above sea level. The elevation of the northern half varies from 10 m. to 110 m., with an average of 64 m; while that of southern half ranges from 5 m. to 70 m., with an average of 41 m. Thus the city gradually slopes from north to south.

Quezon City has two distinct seasons: wet, from the later part of May to the early part of November, and dry, from the later part of November to the early part of May. The rainfalls (Table 1) reach their peaks in July and August, then gradually taper off toward the dry months. More than 50 per cent of the river branches dry up from February to May and thus reduce the breeding habitats.

TABLE 1.—*The total monthly rainfall and rainy days in La Mesa, Novaliches, Rizal, from 1939 to 1941*

Month	1939		1940		1941	
	Rainfall in mm.	Number of rainy days	Rainfall in mm.	Number of rainy days	Rainfall in mm.	Number of rainy days
January	15.60	7	57.20	5	32.80	6
February	0.50	1	29.70	1	0.80	1
March	29.00	3	1.27	1	3.30	1
April	79.50	11	59.00	4	20.80	1
May	147.61	17	164.00	11	51.50	10
June	193.65	21	336.00	24	383.89	20
July	577.10	25	768.20	29	419.00	14
August	544.20	29	416.80	27	612.90	27
September	330.20	20	394.20	21	299.80	22
October	250.30	17	184.20	15	225.58	19
November	128.10	19	31.10	9	46.44	18
December	215.80	9	85.00	7	54.10	8
Total	2,506.06	179	2,471.67	154	2,149.41	147

The northern part of the city has been selected as the site for the proposed capitol. At present, it consists of undeveloped cogonal land, traversed by the Novaliches and Marikina rivers and their tributaries, with prolific breeding of the malaria-vector species. That section of the city is actually malarious. Malaria was so markedly prevalent from 1927 to 1929 in La Mesa, South and North Portal areas (1, 2, 3), which are located in the capitol site, that laborers and their families residing there for the Angat–Novaliches Water Projects of the Metropolitan Water District were seriously affected. The labor force had to be replenished continuously to finish the projects. At that time, it was not uncommon for transients in the region to contract malaria within a short time.

The southern part is fairly inhabited, with modern residential houses. It has been observed that in this section, malaria is not as bad as in the northern part, probably because the tributaries of San Juan and Marikina rivers traversing it afford relatively few habitats to *A. minimus* var. *flavirostris* (Ludlow), the known malaria transmitter.

It will be noted that Quezon City is composed of markedly rural as well as urban districts. It may therefore be considered as a miniature replica of the malarial picture in the Philippines, wherein the disease is prevalent in the rural areas, but not so in the urban.

The population of Quezon City as of 1948 was estimated at 107,977. The people are businessmen, professionals, employees, farmers, and laborers doing sundry jobs. There is no particular industry that is exceptionally conspicuous in the city.

The present paper is based on our studies on malaria and its control in Quezon City from 1938 to 1941 and in 1948.

METHODS OF STUDY

We divided the city for convenience into two districts by the Banlat road to Balara from where it is continued by dotted lines to the Marikina river (see map).

The Northern Rural District is bounded on the north by an imaginary line passing beyond the tip of the M.W.D. Novaliches Water Reservoir crossing the Novaliches–Ipo road at about Km. 24; on the south by aforementioned division land-marks; on the east by Marikina river; and on the west by Manila–Novaliches road.

The Southern Urban District lies south of the above-mentioned District, bounded on the east by Marikina river; on the west by the Manila–Novaliches road and the City of Manila; and on the south by San Juan, Rizal, Camp Crame, and Camp Murphy.

House to house canvasses in 1948 were carried out in four representative sections of Novaliches to determine the morbidity rates in the Northern Rural District. Parasite and spleen rates from both the Northern Rural and Southern Urban District were obtained from well distributed classes of inhabitants in grouped areas. The morbidity rates in the Southern Urban District, however, were supplied by the office of the City Health Officer.

For anophelism, particular attention was directed to *A. minimus* var. *flavirostris*, the most efficient and well-known vector of malaria in the Philippines, without overlooking *A. maculatus* (Theobold) (4, 5) and *A. mangyanus* (Banks) (6) both already reported as malaria transmitters in this country.

Systematic surveys were made of all possible larval breeding habitats and imaginal day-resting places. Two animal-baited traps were erected: one in the Southern Urban District near the City Hall, and the other in the Northern Rural District at San Bartolome, west of the Capitol Site.

RESULTS AND DISCUSSION

THE NORTHERN RURAL DISTRICT

Observations on human host.—From the weekly house to house canvass in four representative sitios of Novaliches for malaria patients, the following malaria morbidity rates per 1,000 per annum were obtained during 1948:

1948	*Pasong Putik*	*Gulod*	*Sta. Monica*	*San Agustin*
ry	750	216	702	750
ary	937	309	585	937
March	812	340	702	812
April	562	278	820	562
May	625	309	585	625
June	500	186	410	500
July	687	216	410	417
August	500	247	468	371
mber	500	186	351	224
er	688	371	585	556
nber [a]	....	....	....	....
nber	500	216	293	371

The records of the local Health Officer include mortality rates not for each of the foregoing sitios, but for the whole barrio of Novaliches. The mortality record from malaria per 1,000 population for 1948 was as follows:

January	0	May	0	September	0
February	0	June	0	October	0
March	1.2	July	0	November	0
April	1.2	August	0	December	2.4

Total .... 4.8 per 1,000 per annum

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[a] Canvasser was removed to an emergency assignment.

TABLE 2.—*The parasite and spleen surveys in the Northern Rural District (September 6, 1948 to October 13, 1948) and Southern District (September 28, 1948 to October 22, 1948), Quezon City*

Districts	Age groups	Number examined	Total positive blood	Rate	Total positive spleen[1]	Rate	Total gamete	Rate	Remarks
				Per cent		*Per cent*		*Per cent*	
Northern District:	Under 2 years	31	0	0	0	0	0	0	
Novaliches to	2 to 10 years	232	10	4.31	21	9.05	0	0	6 *P. vivax*
San Bartolome	Above 10 years	338	8	2.37	18	5.33	0	0	12 *P. falciparum*
	All ages	601	18	2.99	39	6.49	9	1.50	
Bagbag	Under 2 years	12	1	8.33	2	16.67	0	0	
Talipapa to	2 to 10 years	381	5	1.31	23	6.04	0	0	
Sangandaan	Above 10 years	381	5	1.31	17	4.46	0	0	6 *P. vivax*
	All ages	774	11	1.42	42	5.43	9	1.16	5 *P. falciparum*
Pasong Tamo	Under 2 years	4	0	0	0	0	0	0	
Culiat to	2 to 10 years	205	2	0.98	8	3.90	0	0	
Balara	Above 10 years	148	2	1.35	7	4.78	0	0	2 *P. vivax*
	All ages	357	4	1.12	15	4.20	4	1.12	2 *P. falciparum*
	Under 2 years	47	1	2.13	2	4.26	0	0	
Totals	2 to 10 years	818	17	2.08	52	6.36	0	0	
	Above 10 years	867	15	1.73	42	4.84	22	2.52	14 *P. vivax*
	All ages	1,732	33	1.90	96	5.54	22	1.27	19 *P. falciparum*
Southern District:	Under 2 years	46	0	0			0	0	
Cubao	2 to 10 years	958	0	0	0	0	0	0	
Kamuning	Above 10 years	1,164	2	0.17	0	0	0	0	2 *P. vivax* from
Diliman	All ages	2,168	2	0.09	0	0	0	0	Nueva Ecija
Balara Filter	Under 2 years	24	2	8.33			1	4.1	
Compound	2 to 10 years	45	1	2.22	2	4.44	1	2.0	
	Above 10 years	94	1	1.10	1	1.10	0	0	2 *P. vivax*
	All ages	163	4	2.45	3	1.84	3	1.80	2 *P. falciparum*
	Under 2 years	21	0	0			0	0	
San Francisco del Monte	2 to 10 years	634	0	0	0	0	0	0	
San Jose	Above 10 years	629	0	0	1	0.16	0	0	
Bañlintawak	All ages	1,284	0	0	1	0.07	0	0	
	Under 2 years	91	2	2.20	0	0	0	0	
Totals	2 to 10 years	1,637	1	0.06	2	0.12	0	0	
	Above 10 years	1,887	3	0.16	2	0.11	0	0	4 *P. vivax*
	All ages	3,615	6	0.16	4	0.11	3	0.08	2 *P. falciparum*

[1] The splenic enlargements according to degree 1, 2, 3, and 4 were 55, 30, 11, and zero, respectively.

Parasite and spleen surveys were made in three "group areas", namely, Novaliches to San Bartolome; Bagbag and Talipapa to Sangandaan and Baesa; and Pasong Tamo and Culiat to Balara. The results of these surveys were consolidated in Table 2, from which the following salient points may be deduced:

1. The total blood positives were found to be 14 *P. vivax* (Grassi et Feletti), or 42 per cent, and 19 *P. falciparum* (Welch), or 58 per cent. No *P. malariæ* (Laveran) was noted.
2. Evidence of autochthonous recent malaria, because of infections in infants.
3. Parasite and spleen rates in children from 2 to 10 years of age range from 0.98 per cent to 4.31 per cent, average 2.08 per cent and from 3.90 per cent to 9.05 per cent, average 6.36 per cent, respectively; in subjects above 10 years of age, from 1.31 per cent to 2.37 per cent, average 1.73 per cent and from 4.46 per cent to 5.33 per cent, average 4.84 per cent, respectively.
4. There is an apparent progressively gradual reduction in positive bloods and spleens from Novaliches (most northern and highest part of the city) to Balara (eastern outskirt of the southern part).
5. In all age groups, summary findings show 1.90 per cent and 5.54 per cent for positive blood and spleen, respectively.
6. In "group areas" in the North Rural District, the gametocyte rates were 1.50 per cent, 1.16 per cent, and 1.12 per cent, respectively, with a general average of 1.27 per cent. Of the total 33 blood positives, 22 or 67 per cent were of gametocyte and 11 or 33 per cent were of asexual forms.

Such apparently low parasitemia and splenomegaly at present, however, are not a guarantee of safety from future malaria epidemic (11), because of the significant number of gametocyte carriers and of the environmental conditions favoring the propagation of the mosquito vector which may play havoc among the new susceptible settlers in the northern rural areas of the city.

Observation of anophelism.—In the Northern Rural District, our findings on the collection of Anopheles larvæe are consolidated in Table 3. There is noticeably significant preponderance of *A. minimus* var. *flavirostris* larvæ (80.56 per cent in Marikina river tributaries, and 62.05 per cent in Novaliches river and tributaries), over all other species because of the relatively more primitive state of the area. By contrast, in the upper tributaries of San Juan river just north of the Banlat road, the vector species was observed only to be 30.2 per cent,

TABLE 3.—*Showing the results of Anopheles larvæ checking in the Northern Rural District (October 1-11, 1948) and Southern Urban District, (Sept. 2 to October 12, 1948), Quezon City*

Anopheles	Northern Rural District									Southern District			Remarks
	Marikina River and tributaries			Novaliches River and tributaries			San Juan River and upper tributaries			From 25 tributaries of San Juan River			
	Larvæ in 1,360 dips	Density per dip	Rate	Larvæ in 1.250 dips	Density per dip	Rate	Larvæ in 1,120 dips	Density per dip	Rate	Larvæ in 1,330 dips	Density per dip	Rate	
			Per cent			*Per cent*			*Per cent*			*Per cent*	
Minimus var. *flavirostris*	203	0.15	80.56	103	0.08	62.05	81	0.02	30.22	125	0.09	17.09	
Hyrcanus var. *nigerrimus*	22	0.02	8.73	23	0.028	13.86	35	0.03	13.05	52	0.04	7.11	
Lesteri	4	0.003	1.59	16	0.010	9.64	19	0.02	7.09	367	0.28	50.20	
Manalangi	13	0.009	5.16	2	0.002	1.20	26	0.02	9.70	8	0.06	1.09	
Annularis	5	0.004	1.98	2	0.002	1.20	6	0.005	2.24	30	0.02	4.10	
Kochi	5	0.004	1.98	1	0.001	0.60	0	0	0	0	0	0	
Filipinæ	0	0	0	6	0.004	3.61	1	0.001	0.37	12	0.09	1.64	
Philippinensis	0	0	0	8	0.006	4.82	4	0.003	1.49	59	0.04	8.07	
Barbirostris	0	0	0	5	0.004	3.01	0	0	0	2	0.002	0.27	
Vagus var. *limosus*	0	0	0	0	0	0	96	0.09	35.82	76	0.06	10.40	
Total	252	0.185	100.00	166	0.13	99.90	268	0.24	99.80	731	0.55	99.98	

TABLE 4.—*Anopheles adult catches from their daytime resting places in the Northern Rural District, (October 1–11, 1948) and the Southern Urban District, (August 25 to October 12, 1948), Quezon City*

Anopheles	Northern Rural District						Southern Urban District		Remarks
	Marikina River and tributaries		Novaliches River and tributaries		San Juan River and upper tributaries		San Juan River and Mariablo lower tributaries		
	Number			*Per cent*	Number			*Per cent*	
Minimus var. *flavirostris*	48	68.57	22	48.88	4	18.18	3.	20.00	Marikina River includes 27 tributaries.
Filipinae	1	1.43	8	17.78	2	9.09	1	6.66	
Hyrcanus var. *nigerrimus*	6	8.57	2	4.44	8	36.36	0	0	
Manalangi	2	2.86	2	44.4	1	4.55	0	0	
Tessellatus	4	5.71	1	2.22	0	0	0	0	
Vagus var. *limosus*	1	1.43	4	8.88	0	0	10	66.66	Novaliches River includes 22 tributaries.
Philippinensis	4	5.71	4	8.88	4	18.18	0	0	
Annularis	2	2.86	0	0	1	4.55	0	0	
Karwari	2	2.86	0	0	0	0	0	0	
Lesteri	0	0	1	2.22	1	4.55	1	6.66	San Juan River includes 14 tributaries in rural district.[1]
Kochi	0	0	1	2.22	1	4.55	0	0	
Subpictus var. *indifinitus*	0	0	0	0	0	0	0	0	
Total	70	100.00	45	99.96	22	100.00	15	99.98	

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[1] San Juan River tributaries in Urban district had in 4 spots only positive for Anopheles adults in a total of about 12 kilometers of streams

which was surpassed by *A. vagus* var. *limosus* (King), stagnant water breeder by more than five per cent. This might be attributed (*a*) to the hydrotechnical measures instituted in some streams north of the University of the Philippines site by the Malaria Control Section before the war, (*b*) to the agricultural development in the area south of the Capitol site and north of the Banlat road to Balara, (*c*) to the other biological changes in the streams due to the presence of sizeable flocks of livestock, and (*d*) to the fact that the water in the upper tributaries of San Juan river tends to stagnate, as it traverses a low-lying area,—of very much lower elevation than those of Marikina and Novaliches rivers.

Larval densities (see Table 3) of *A. minimus* var. *flavirostris* were 0.15 l.p.d.[a] in Marikina river tributaries, 0.08 l.p.d. in Novaliches river and tributaries, and 0.07 l.p.d. in the upper tributaries of San Juan river. These figures are significantly higher than those obtained for other species, except for *A. vagus* var. *limosus* in the last named stream. Other larvæ included in the collections were *A. hyrcanus* var. *nigerrimus* (Giles), *A. hyrcanus* var. *lesteri* (Baisas et Hu), *A. manalangi* (Mendoza), *A. annularis* (Van der Wulp), *A. kochi* (Doenitz), *A. filipinæ* (Manalang), *A. philippinensis* (Ludlow), and *A. barbirostris* (Van der Wulp).

Anopheles imagines caught in their daytime resting places (see Table 4) were *A. minimus* var. *flavirostris*, *A. filipinæ*, *A. hyrcanus* var. *nigerrimus*, *A. manalangi*, *A. tessellatus* Theo., *A. vagus* var. *limosus*, *A. philippinensis*, *A. annularis*, *A. karwari* (James), *A. hyrcanus* var. *lesteri*, and *A. kochi* (Doenitz). Like its larva, *A. minimus* var. *flavirostris* adults from its daytime resting places outranked markedly the other species in Marikina river tributaries (68.57 per cent) and in Novaliches river and tributaries (48.88 per cent). However, this is not the case in the upper tributaries of San Juan river north of Banlat road where *A. hyrcanus* var. *nigerrimus* predominates over other species probably because of the abundance of ricefields in the neighborhood and other factors already described about Anopheles larvæ. It might be noted that *A. karwari* adults were trapped, but its larvæ were not found because of the paucity of its preferential breeding habitats.

It appears on Table 5 that catches on the sixteen species of Anopheles from the animal-baited trap at Sitio San Bartolome in November to December 1948, are at variance, probably because of the seasonal occurrence of their preferential breeding habitats within their flight range to the trap. The prevalence of Anopheles imagines caught ranked from the highest to the lowest, is as follows:

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[a] l.p.d.—larva per dip.

1. *A. vagus* var. *limosus*
2. *A. philippinensis*
3. *A. subpictus* var. *indefinitus* (Ludlow)
4. *A. annularis*
5. *A. filipinæ*
6. *A. minimus* var. *flavirostris*
7. *A. manalangi* and *A. tessellatus*
8. *A. litoralis*
9. *A. hyrcanus* var. *nigerrimus*
10. *A. barbirostris*
11. *A. karwari*
12. *A. hyrcanus* var. *lesteri* and *A. kochi*
13. *A. maculatus*
14. *A. ludlowi*

A. maculatus was insignificantly present in the area.

TABLE 5.—*The Anopheles adult trap catches in the Northern Rural District and Southern Urban District, Quezon City*

Anopheles	San Bartolome Northern District				Kamuning Southern District	
	252 trap-hours November 1948		252 trap-hours December 1948		160 trap-hours	
	Number	Density	Number	Density	Number	Density
Minimus var. *flavirostris*	222	0.88	95	0.38	2	0.01
Maculatus	2	0.007	0		0	0
Filipinæ	180	0.71	153	0.61	3	0.02
Vagus var. *limosus*	622	2.47	150	0.60	1,787	11.17
Subpictus var. *indifinitus*	399	1.58	221	.088	29	0.18
Ludlowi	1	0.004	0	0	0	0
Citoralis	18	0.05	85	0.34	0	0
Manalangi	103	0.41	22	0.09	2	0.01
Lesteri	7	0.03	6	0.02	252	1.58
Hyrcanus var. *nigerrimus*	259	1.08	72	0.30	363	2.27
Barbirostris	40	0.16	20	0.09	14	0.09
Karwari	16	0.06	3	0.01	0	0
Kochi	8	0.03	5	0.02	0	0
Tesselatus	19	0.08	116	0.46	14	0.09
Annularis	400	1.59	38	0.15	522	3.26
Philippinensis	5,878	20.9	96	0.38	101	0.63
Total	7,669	30.43	1,082	4.29	8,087	1.92

[1] Number of mosquitoes trapped divided by the number of trapping hours gives the density per hour.

THE SOUTHERN URBAN DISTRICT

Observations on the human host.—The following is a record on malaria morbidity and mortality during 1948 from the Office of the City Health Officer of Quezon City, located in this District:

Annual morbidity and mortality from malaria per 1,000 population

Month	Cases	Morbidity	Deaths	Mortality
1948				
January	5	0.090	1	0.018
February	2	0.046	0	0
March	1	0.018	0	0
April	4	0.072	0	0
May	9	0.162	0	0
June	7	0.126	0	0
July	6	0.108	0	0
August	7	0.126	0	0
September	12	0.216	0	0
October	2	0.036	0	0
November	8	0.144	2	0.036
December	2	0.036	0	0
Total	65	1.170	3	0.054

Parasite and spleen surveys among the three age-groups were made in ten places (grouped into 3 areas according to their natural features, and locations) in the district (Table 2). The following points may be deduced:

1. There was no significant difference in number between *P. vivax* and *P. falciparum*. They were too few to merit comparative consideration.

2. Out of ten places grouped into three representative areas only the Balara Filter Compound showed evidence of autochthonous recent malaria through observed infant infection with 8.33 per cent.

3. Parasite and spleen indices in children from 2 to 10 years of age were 2.22 per cent and 4.44 per cent, respectively. These data were, however, obtained in Balara Filter Compound only. In subjects above ten years of age, they ranged from 0.17 per cent to 1.1 per cent with an average of 0.16 per cent in 1,887 examinations for parasites, and from zero to 1.10 per cent spleen with an average of 0.11 per cent; but those positive cases encountered at the South market neighborhood, Diliman, were apparently imported from Nueva Ecija.

4. The Balara Filter Compound, which is the most elevated in the district, showed outstanding parasite and spleen rates with 1.8 per cent gametocyte rate, while the low-lying areas showed negative findings.

5. For all age groups, the parasite and spleen rates were reduced to 0.16 per cent and 0.11 per cent, respectively.

Observations on anophelism.—Findings on Anopheles larvæ are shown in Table 3. It will be noted that, in 1,330 well distributed dips in twenty-five tributaries of San Juan River, *A. minimus* var. *flavirostris* was second only to *A. hyrcanus* var. *lesteri,* and constituted 17.09 per cent and 50 per cent, respectively. These figures apparently show that about 83 per cent of the breeding habitats harbored harmless species, because of the permanent control works effected in streams during the prewar period. Other larvæ collected were identified as *A. vagus* var. *limosus, A. philippinensis, A. hyrcanus* var. *nigerrimus, A. annularis, A. filipinæ, A. manalangi,* and *A. barbirostris,* in the order of their abundance.

The Anopheles imagines from their daytime resting places and the animal-baited traps are presented in Tables 4 and 5, respectively. It will be noted that only two *A. minimus* var. *flavirostris* adults were trapped among 3,087 Anopheles adults during the period from August 25, 1945 to October 12, 1948 (observed favorable season for the dispersion of the species).

The species trapped are ranked as follows:

1. *A. vagus* var. *limosus*
2. *A. annularis*
3. *A. hyrcanus* var. *nigerrimus*
4. *A. hyrcanus* var. *lesteri*
5. *A. philippinensis*
6. *A. subpictus* var. *indefinitus*
7. *A. barbirostris* and *A. tessellatus*
8. *A. manalangi* and *A. minimus* var. *flavirostris*

In spite of the extensive search by a group of six trained men, captures of Anopheles imagines in their daytime resting places (Table 4) along the borders of the streams were few, owing to finished control measures. *A. minimus* var. *flavirostris, A. filipinæ, A. vagus* var. *limosus,* and *A. hyrcanus* var. *lesteri* were caught from only four spots in view of the extensive elimination of favorable harborages before the war.

MALARIA CONTROL WORKS IN THE SOUTHERN URBAN DISTRICT [1]

In the Southern Urban District, unlike that of the Northern Rural District, malaria control works financed from fiduciary funds from the University of the Philippines, and from the Administration of Quezon City were undertaken by the Malaria Control Section of the Department of Health in the U. P. Site and in other areas of the district from November 1938 to November 1941. The accomplishments and effective results as shown in the findings on anophelism in the locality were as follows:

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[1] Compiled from the records of the Section of Malaria Control.

Accomplishments in the field	Meters
Automatic siphon sluices (Pl. 1, fig. 1)	6
Canals in the main streams (Pl. 1, fig. 2)	2,240.00
Ordinary "ripraps" (Pl. 1, fig. 3)	1,298.00
Semi-culverts (Pl. 2, fig. 4, 5, 7)	1,977.55
Canals dugged in natural adobe stone (Pl. 2, fig. 6)	1,343.99
Total	6,859.94

In addition to the permanent hydrotechnical control measures, temporary measures such as spreading of one per cent Paris green with fine road dust, in the unimproved streams, and clearing and sloping stream banks to destroy Anopheline harborages, were also undertaken.

Gradual and steady decrease of *A. minimus* var. *flavirostris* larva in relation to the other species resulted as the important breeding habitats were destroyed by the application of hydrotechnical measures. The yearly reductions were as follows:

Year 1938—19,484 in 38,801 total larva collection, or about 50 per cent.
Year 1939—52,322 in 116,462 total larva collection, or about 45 per cent.
Year 1940—7,741 in 31,877 total larva collection, or about 24 per cent.
Year 1941—1,312 in 5,928 total larva collection, or about 20 per cent.

The annual larval densities were steadily reduced as follows:

1938	.90 l.p.d.	1940	0.07 l.p.d.
1939	0.40 l.p.d.	1941	0.02 l.p.d.

Other Anopheles species had very low annual larval densities, as shown below:

	1938 l.p.d.	1939 l.p.d.	1940 l.p.d.	1941 l.p.d.
A. manalangi	0	0	0.01	0.02
A. filipinae	0.01	0.01	0.002	nil
A. karwari	0	0	nil	0
A. ludlowi	0	0	0	0.002
A. vagus var. *limosus*	0.02	0.09	0.08	0.03
A. barbirostris	0.78	0.34	0.09	0.01
A. hyrcanus var. *nigerrimus*	0.02	0.003	0.001	0.01

A. subpictus var. *indefinitus*	0	0.001	0.01	0.01
A. kochi	nil	nil	nil	0
A. philippinensis	0.03	0.02	0.001	0.001
A. annularis	0.02	0.02	0.01	0.003
A. hycarnus var. *lesteri*	0.004	nil	nil	0
A. maculatus	0	0	nil	0

Available records of the human-baited, and carabao-baited traps for the months of June, July and October, 1941, in Barangca, Quezon City, show that, of 343 anopheles adults trapped in the former, no *A. minimus* var. *flavirostris* was found; while in the latter, out of 24,957 imagines caught only 15 of the vector species or 0.06 per cent were noted.

The results of the catches in the animal-baited trap in Diliman near Tanke Creek show that the average annual density of *A. minimus* var. *flavirostris* was 0.42 a.p.t.h.[a] in 1940, as compared with only 0.18 a.p.t.h. in 1941. Moreover, it was 0.66 per cent in 1940 in a total of 187,013 trapped imagines, as compared with 0.20 per cent in 1941 in a total of 509 caught adults. To show its relation with the other species, the following results are presented:

Anopheles	1940		1941	
	Annual average Adult density	Adult in per cent	Annual average Adult density	Ad ult in per cent
Minimus var.				
flavirostris	0.42	0.66	0.18	0.20
Naculatus	0.004	0.01	0	0
Manalangi	0.36	0.56	0.24	0.26
Filipinae	0.23	0.36	0.03	0.03
Litoralis	0.25	0.39	0.08	0.06
Ludlowi	1.15	1.81	0.52	0.56
Vagus var. *limoeus*	14.24	22.31	16.36	17.54
Subpictus var.				
Indifinitus	2.83	4.43	1.14	1.21
Barbirostris	0.05	0.08	0.05	0.05
Hyrcanus var.				
Nigerrimus	4.04	6.34	11.18	11.99
Tesselatus	0.20	0.31	0.10	0.10
Philippinensis	20.66	32.86	22.99	24.66
Annularis	19.29	30.22	40.40	43.33
Karwari	0.05	0.07	0	0
Kochi	0.06	0.09	0.004	0

A full year of trapping 1941 in Barrio Obrero gave the following results with carabao as bait:

	Annual average density a.p.t.h.	*Adults in per cent*
A. minimus var. *flavirostris*	0.43	1.38
A. manalangi	0.31	1.33

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[a] Adults per trapping hour

A. *filipinæ*	0.05	0.24
A. *litoralis*	0.01	0.06
A. *ludlowi*	0.25	1.09
A. *vagus* var. *limosus*	11.11	47.37
A. *subpictus* var. *indefinitus*	0.71	3.00
A. *barbirostris*	0.01	0.03
A. *hyrcanus* var. *nigerrimus*	5.07	21.58
A. *tessellatus*	0.06	0.25
A. *philippinensis*	2.05	8.75
A. *annularis*	3.38	14.41
A. *karwari*	nil	0.001
A. *kochi*	0.001	0.003

Thus, it might be noted that harmless species, particularly *A. vagus* var. *limosus*, *A. hyrcanus* var. *nigerrimus*, *A. annularis*, and *A. philippinensis* predominate over *A. minimus* var. *flavirostris.*

The effect of the mosquito control (anti-imaginal) measures appears most significant on *A. minimus* var. *flavirostris* density in their daytime resting places in relation with other species. The average annual density per man-hour search dropped from 0.03 a.p.m.h.s.[a] in 1938 to 0.01 a.p.m.h.s. in 1939, 0.003 a.p.m.h.s. in 1940 and 0.002 a.p.m.h.s. in 1941.

In comparison with the minimum *A. minimus* var. *flavirostris* density of 33.8 a.p.m.h.s. during the favorable dispersion months in the area near the South Portal, La Mesa, Novaliches, in 1932 (10), the foregoing findings are indeed negligible, considering that *A. minimus* var. *flavirostris* constituted 80 per cent in 1938; 51.54 per cent in 1939; 44.52 per cent in 1940; and only 8.96 per cent in 1941 of the total annual Anopheles harborage catches in Quezon City.

The human-baited trap in Diliman registered a very low *A. minimus* var. *flavirostris* density with 0.02 a.p.t.h. as its peak from January, 1940 to November, 1941. In barrio Obrero, Kamuning Street, from January to November, 1941, a peak of only 0.05 a.p.t.h. was obtained with the human-baited trap. It is, therefore, evident that, judged from the paucity of the vector-species, malaria was of minor importance in the Southern Urban District of Quezon City. Such small catches of *A. minimus* var. *flavirostris* may be attributed to the hydrotechnical measures introduced in the City.

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[a] Adults per man-hour search

SUMMARY AND CONCLUSION

1. Malaria is presently endemic among the inhabitants of the communities surrounding the Capitol Site. The endemicity gradually decreases from the Northern limit of the city southward to the communities near the University of the Philippines site.

2. Malaria is absent in that part of the Southern Urban District close to Manila and San Juan, Rizal.

3. The density of the mosquito vector, *Anopheles minimus* var. *flavirostris*, decreases as the land development increases southward from the Northern to the Southern boundaries of the city.

4. The mosquito control measures (anti-larval and anti-imaginal) directed against the vector species have redounded to the control of malaria in the Southern Urban District. The effetcive and practical value of permanent control measures have been demonstrated.

5. The malaria picture in Quezon City is what is usually seen in other areas of the Philippines, in that the disease is present in primitive barrios and sitios, but insignificant or absent in developed cities and towns, in conformity with the natural habitats of the vector species.

6. *A. maculatus* appears in a very low density, while *A. mangyanus* is absent.

RECOMMENDATIONS

In the light of our findings on malaria in Quezon City, we offer the following recommendations:

1. A committee consisting of malariologists, entomologists, and sanitary engineers to draw plan and program of malaria control should be created.

2. The necessary funds should be provided to carry out the plan and program drawn.

3. In consonance with the city building, we recommend permanent malaria control works:—these will be the continuation of the permanent hydrotechnical measures presently existing in the Southern Urban District, and their extension in the Northern Rural District of the City. In the construction of such permanent structures, the Master Plan Layout of the City must be consulted. Such projects will improve the general sanitation and beautify the locality.

4. Temporary anti-malaria measures may be resorted to, if and when scientific observations warrant their applications. In

so doing unnecessary loss of time and wastage of money may be avoided.

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ILLUSTRATIONS

PLATE 1

FIG. 1. Automatic siphon sluice, University of the Philippines Site (Southern Urban District), Quezon City.

2. Raprapped canal for river tributary. Balara Filter Site (Southern Urban District), Quezon City.

3. Ordinary "ripraps" after straightening a small stream. Diliman Site (Southern Urban District), Quezon City.

PLATE 2

FIG. 4. Inverts with adobe "ripraps" and cement tiles (manufactured by the Unit) for shoulders. University of the Philippines Site (Southern Urban District), Quezon City.

5. Laying out the drainage system. University of the Philippines Site (Southern Urban District), Quezon City.

6. Canal dugged in natural adobe stone (stream bed) Balara Filter Site (Southern Urban District), Quezon City.

7. Inverts finished with cement tiles. University of the Philippines Site (Southern Urban District), Quezon City.

REVIEW OF PHILIPPINE BASEMENT GEOLOGY AND ITS PROBLEMS[1]

By EARL M. IRVING
Of the Geologist, U. S. Geological Survey

ONE PLATE AND FIVE TEXT FIGURES

INTRODUCTION

Consideration of the basement formations arises in connection with the compilation of a new geologic map of the archipelago by the Philippine Bureau of Mines.

Basement formations crop out in the cores of many Tertiary mountain ranges and underlie approximately thirty per cent of the land area of the Philippine archipelago. The rocks consist of sedimentary and volcanic types that are metamorphosed to varying degrees and these are cut by a wide variety of plutonic and hypabissal igneous intrusives. The oldest paleontologically dated formations overlying the essentially crystalline basement are lower to middle Tertiary in age; the oldest dated formation within the basement rocks is Jurassic in age, accordingly, if the history of the Philippine archipelago has been comparable to that of adjoining archipelagos or to the continental mainland, possibly as much as 80 to 90 per cent of geologic time may be represented within them.

The present review, consisting of a compilation of published as well as unpublished data, attempts to describe briefly the distribution, constitution, and geologic relations of the basement formations as they are now known on each of the principal islands, or island groups, of the archipelago. Owing to great hiati of information, and generally inadequate descriptions rising out of many previous investigations, the compilation serves to emphasize how imperfectly the basement formations are known or understood. If the paper fails to convey an adequate concept of the rock units, perhaps its value lies in the stimulation of present and future students toward their more precise study in the future.

Certain problems and tentative generalizations are set forth at the conclusion of the paper.

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[1] Prepared for the Seventh Pacific Science Congress, Auckland, New Zealand, February 1949, and published by permission of the Director, U. S. Geological Survey.

ISLAND OF LUZON

The largest area of basement formations of the Philippines (Plate I) is exposed in the high cordillera of northern and eastern Luzon. The outcrop area is "Y" shaped. The western leg outcrops along the northwestern cordillera of the Ilocos and Mountain Provinces, and the eastern leg, including the stem of the "Y", follows along the Sierra Madre cordillera of the Pacific coast. Another large area crops out along the Zambales Range on the west-central side of the island. Several smaller areas are exposed along the peninsular ranges of the Pacific coast in southeastern Luzon and on adjacent islands to the east.

NORTHWESTERN CORDILLERA

Ilocos provinces.—One of the earliest investigations of the older formations of Luzon was undertaken by W. D. Smith (1907) in Ilocos Norte Province.

On the left bank of the north-flowing Baruyen River, Smith found float boulders and local outcrops of red, fine-grained, fissile chert which breaks into slabs 5 millimeters to several centimeters thick; to it he assigned the term "Baruyen chert".

Smith described thin-sections of the chert as follows:

> "This rock is seen to consist of a fine grained, amorphous groundmass of chalcedonic silica, copiously stained with oxide of iron, with almost innumerable round and oval areas which are more or less clear. In ordinary light the whole section resembles sections of some of the radiolaria cherts of the San Francisco peninsula, to judge from my memory of them and from descriptions."

Besides finding what he believed to be *Podocrystis* and *Bothryocampo* in the Ilocos cherts, at a much later date Smith (1924, p. 72) stated that he was able to identify specific forms of the genera *Cenosphaera* and *Dictyomitra* in specimens of lithologically similar cherts from Panay and Balabac Islands. These findings and their circumstantial association with serpentine, like the bedded cherts of the Franciscan formation of California with serpentine, lead him to assign the cherts a tentative Jurassic age.

During recent investigation of the area (Irving and Quema, 1948) large bodies of chert were found closely associated with serpentine and chloritic schist, but some are locally interleaved with serpentinous schist. The chert deposits are intensely folded along northwesterly trending axes, and are strongly fractured and brecciated. In many areas the fractures and the interstices of the breccias are filled or healed by chalcedony and fine-granular quartz. The formation is intruded, discordantly in general, by peridotite and serpentinite which themselves possess schistosity and shearing parallel to regional basement structure. The basement upon which the cherts were deposited could not be distinguished.

Intruding the cherts and serpentines as dikes in the headwaters of the westward draining Caraon River, and as small lenticular bodies elsewhere, a white, eugranitic to gneissoid rock consisting of oligoclase, quartz, and muscovite was analyzed by L. A. Salinger of the Bureau of Science in 1906 with the following results: SiO_2, 72.76 per cent; Al_2O_3, 15.15 per cent; NaO, 5.06 per cent; and K_2O, 0.56 per cent. Another analysis by H. Moreno of the same bureau in 1941 gave SiO_2, 68.86 per cent; Al_2O_3, 18.16 per cent; Na_2O, 7.96 per cent; and K_2O, 2.42 per cent. Instead of granulite as termed by Smith, the high silica content and the preponderance of soda over potash suggest the rock is possibly *trondhjemite.*

It is now known that cherts of "Baruyen" type occur widely throughout the basement rocks of the Philippines, and may be associated either with other sediments, or more commonly with volcanics which are metamorphosed in varying degrees. While it is true that many contain skeletons of micro-organisms, probably radiolaria, few can be accurately identified in thin-section. Appreciating the general fractious nature of radiolaria for purposes of correlation, the Jurassic age of these cherts, it is believed, must be held with reservation, in view of the fact that lithologically similar cherts occur in many widespread localities, and often under quite different geological associations. The age of the chert and the orogeny involving them in the Ilocos area, and of the intrusion by plutonics, therefore, cannot be dated with certainty. The oldest fossiliferous Tertiary beds overlying these rocks are upper Miocene. A thick section of folded volcanic agglomerates and tuffs lies between the marine Tertiary beds and the basement. These volcanic rocks are not metamorphosed and are probably of lower to middle Tertiary age.

On the highway south of Vigan, Ilocos Sur, diorite crops out at Solvec Point but the strongly folded middle Tertiary sandstone and shale cover obscures the country rocks into which it was intruded.

James Cushing (personal communication) reported that an elliptical north-south trending stock of granitic composition, 20 by 80 kilometers across, intrudes basic volcanics in the Abra gold mining district a few miles east of Bangued, Abra Province.

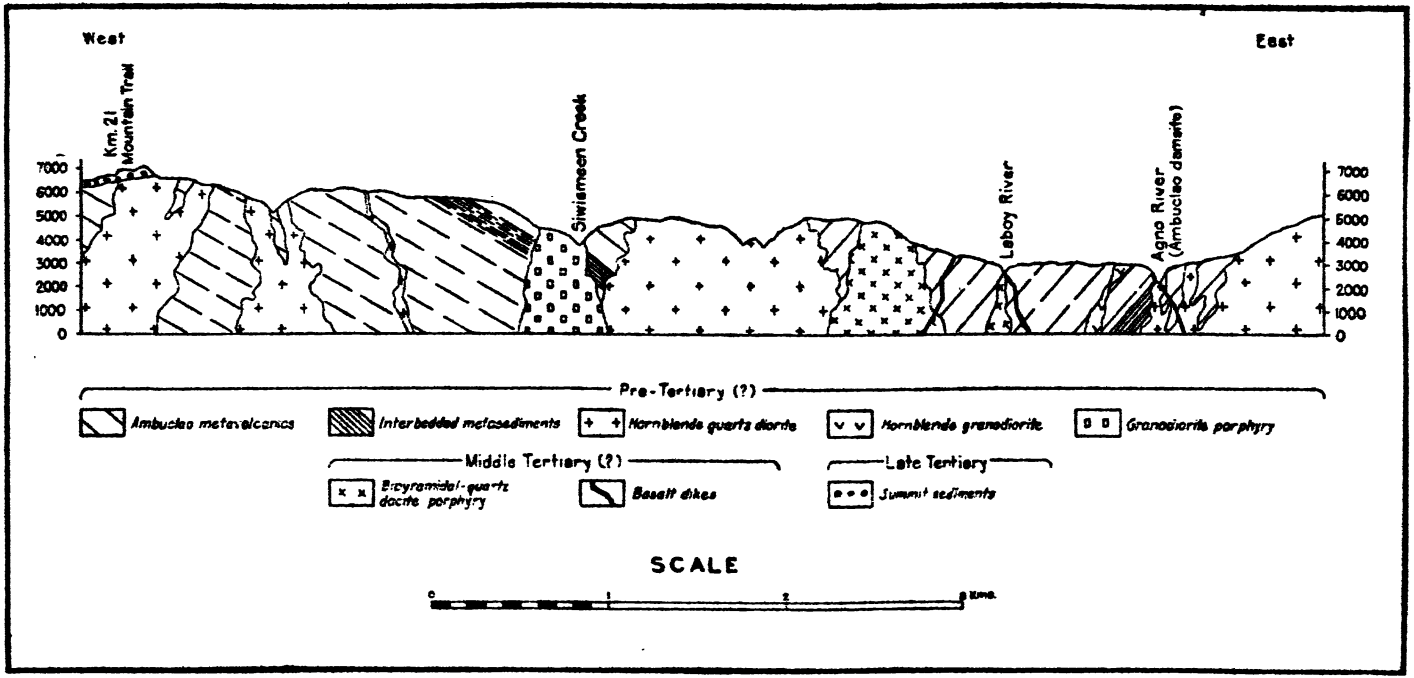

FIG. 2. East-west geologic section from kilometer 21, Mountain Trail, to Ambuclao damsite on the Agno River, Mountain Province, Luzon (Irving and Oca, 1950).

Mountain Province.—While undertaking a reconnaissance of the high cordillera of Mountain Province in 1914, Smith (1915, p. 192) found grayish to whitish biotite granite at two points, one a short distance east of Bontoc and the other in the Saltan Valley. He stated "it appears to be a long intrusive mass whose axis runs from northwest to southeast." Bordering the intrusive granite was found a hornblende quartz diorite which he considered to be the basal formation for that area. These plutonic rocks are more extensive than their present outcrop area and being concealed by overlying extrusive volcanics, the country rock into which they were intruded is not known.

At the Lepanto copper property near Mankayan, the Lepanto ore-body occurs in metamorphosed basic volcanics, probably metaandesite and metabasalt, which, due to recrystallization, have lost most of their primary igneous textures and structures. These rocks are intruded by a large mass of biotite hornblende granodiorite whose contact passes in a north-northwesterly direction through the property. In the vicinity, both rocks are overlain by volcanics, probably of Tertiary age.

During recent foundation investigations of the proposed Ambuclao hydroelectric power damsite near the headwaters of the Agno River, a traverse (Irving and Oca, 1949) was carried across a portion of the central part of the cordillera. The oldest recognizable formation in this area consists of a great thickness of metaandesite and metabasalt, locally containing interbedded chert, impure quartzite, and metagraywacke. The rocks are broadly folded along axes trending N. 15° to 25° E. This folded sequence is broken into three north-south trending belts by elongated intrusives of hornblende quartz diorite which is probably the principal agent of metamorphism of the invaded rocks. This intruded metamorphosed sequence in turn is cut discordantly by smaller bodies of biotite hornblende granodiorite and of biotite feldspar granodiorite porphyry. After deep erosion of the range resulting from this orogeny, large masses of bipyramidal-quartz dacite porphyry were emplaced under a shallow rock cover as evidenced by the fine-grained texture of its groundmass. All of the foregoing were then intruded by thin basalt and andesite dikes that followed various joint systems in the rocks. On the bases of direct geological evidence, of mineral descent in accordance with the reaction principle, and of igneous textures, the first three intrusives appear to belong to a single magmatic cycle probably of pre-

Tertiary age. The dacite porphyry and effusive dikes are supposedly related to late Tertiary volcanism.

Baguio Area.—This renowned mining district has been described by numerous writers. The most comprehensive of these studies was by Andrew Leith (1938). The oldest rocks crop out as local areas in Antamok Valley and at Twin Rivers, near Itogon. They are described as mildly folded metamorphosed rocks, consisting of thinly laminated layers of light-colored siliceous and feldsphatic material, alternating with dark-colored hornblende, biotite, and chlorite-rich layers. Individual lamina are thin but occasional layers reach one to two feet in thickness. Leith believes these rocks are the product of static thermal metamorphism of "originally finely laminated shaly sand, or sandy shale, the fineness of the laminae suggesting a silt deposited in a lake or shallow sea" and that "apparently the folding preceded the development of the metamorphic minerals, for they show no regional parallelism, nor axial plane parallelism, such as is normal in dynamic metamorphism." Metamorphism is attributed to the rise in temperature attendant with widespread invasion of diorite magmas into the sediments when they were in "an unconsolidated condition and not under much load".

From many years of painstaking work in the district, Paul Schafer (personal communication), chief geologist of the Benguet Consolidated Mining Company, has found several additional areas of metamorphosed sediments, which, because of their isolated positions in the field, cannot be readily correlated. The widespread Pugo series in the southern part of the district contains metamorphosed volcanics similar in appearance to those of the Ambuclao area. Other sediments such as in the Atok-Big Wedge and in the Antamok Gold Field mine areas may be metamorphosed equivalents of Leith's Antamok series (Miocene?), or, they may also be parts of the basement. These older rocks are evidently overlain by the widespread, coarse clastic, Zig Zag series, which contains some red beds, and are clearly overlain by the Mirador limestone of Pliocene age.

Wisser (1940) argued that granodiorite intrudes extensive volcanic-rich sediments of "Vigo" (lower Miocene) type. Unfortunately Wisser's forceful argument loses much of its strength through his failure to establish definitely the "Vigo" age of the intruded rocks. Schafer, on the basis of additional evidence, however, agrees in principle with Wisser and goes further to say that the area is intruded by several coarse-grained intrusives, forming an irruptive complex that in part may be of upper Tertiary age, possibly correlative with the Paracale granodiorite of the Paracale Mining district, Camarines Norte.

The basement country rocks and the youngest coarse-grained intrusives enclose the immensely productive veins of the district.

SIERRA MADRE CORDILLERA

Northern Sierra Madre.—In 1913 Eddingfield (Smith, 1924, p. 140) passed by boat around the northern end of the Sierra Madre cordillera and along the northeastern coast of Luzon.

Near the ports of Dimalansan and Bicobian, north of Palanan Bay, Eddingfield reported coarsely crystalline pyroxenite (peridotite?) which is locally schistose, and surmised that it may extend inland as far as Mounts Cresta and Moises. He then reported the rocks near Casiguran Sound, north of Baler Bay, to consist mainly of diorite, andesite, and pyroxenite (peridotite?) which probably extend inland for 12 to 20 kilometers. East of Baler an outcrop of coarsely crystalline pyroxenite similar to that at Palanan Bay was also found.

About 15 kilometers southwest of Baler on the Boñgabon-Baler road, Corby (1940) reports a coarse-grained plutonic rock (diorite?) that appears to intrude serpentine, metamorphosed tuff and volcanics, and agglomerate. Some of the latter are intensely deformed and metamorphosed. Except the serpentine, the formations appear to be similar to the Pugo series, its intrusives, and the superjacent Tertiary volcanic rocks of the Baguio district.

The Central Knot Area.—The area where the Northwestern Cordillera joins the Sierra Madre Cordillera in Nueva Vizcaya Province is frequently termed the "Central Knot". This area is underlain mainly by thick-bedded, tilted Tertiary sandstone, shale, and conglomerate. Abella y Casariego (Smith, 1924, p. 145) stated that these sediments are in contact with diorite, probably by extensive faulting.

Southern Sierra Madre.—The oldest recognized rocks (Irving, 1947) of the Montalban-Mount Balagbag area northeast of Manila consist of andesites and basalts which enclose interbedded horizons varying in the thickness from a few feet up to several hundred feet thick, of thin-bedded to thick-bedded, regularly stratified, dark-gray clastic sediments, including occasional, finely-laminated red and green chert horizons. This interbedded sequence is intensely folded along structural axes trending N.–S. to N. 20° E. and is widely intruded by eugranitic diorite, with local gabbroic facies, and by large bodies of granodiorite exhibiting strong lineal and platy structures which are accordant with the longitudinal structure of the country rocks. Moderate regional thermal metamorphism has converted these volcanics to metaandesite and metabasalt, and the interbedded sediments to hornfels-like argillite, impure quartzite, metaconglomerate, and jasperoidal chert. At Loobac, north of Montalban dam, and at Bosoboso, north of Teresa, isolated outcrops of serpentinized peridotite are exposed in small erosion windows of younger volcanics and for this reason the relationship of the peridotite to other intrusive rocks is not known.

Following deep erosion, lower Miocene conglomerate, sandstone, and shale and the Binañgonan limestones were deposited unconformably on the basement. These sediments in turn were strongly folded, probably in the middle Miocene, along structural axes similar to those of the earlier orogeny. Upper Tertiary volcanism is expressed by intrusion of numerous andesitic dikes into the complex, and by deposition of a thick series of lavas and agglomerates that mantle and bury the southern end of the range opposite Manila.

Judging from pebbles and boulders in rivers draining westward from the range to the north, similar formations probably extend as far north as Cabanatuan and San José, Nueva Ecija Province.

Definite age of the crystalline formations has not been determined. The basement rocks are, however, pre-lower Miocene, and judging from the amount of erosion that preceded deposition of the unmetamorphosed Miocene sediments, they may be Mesozoic or older.

ŻAMBALES RANGE

The Zambales Range is a rugged cordillera extending along the western side of the island and lying between the Central Valley depression and the China Sea to the west. The range is composed of two district groups of igneous rocks of greatly different ages: (1) a belt of Tertiary volcanics along the eastern side of the range consisting of extrusive rocks on the Bataan peninsula and a series of andesite porphyry plugs that extend northward from Bataan peninsula and terminate at about the latitude of Tarlac, and (2) an unresolved complex of much older basic intrusives that extend northward along the western side of the range from the Cinco Picos Peninsula west of Subic Bay to the Hundred Islands area east of Cape Bolinao. The eastern and western bases of the range are bordered by folded middle and upper Tertiary sediments which in turn are overlapped by recently elevated Quaternary sediments.

Smith (1924, p. 122) reports that the Cinco Picos Range west of Subic Bay is composed of pyroxenite, a rock-type found in masses of limited size and commonly associated with gabbroic intrusives. Judging from the large size of the area that supports only a meager vegetation, it is probable that much of the area is underlain by peridotite and serpentine.

At the latitude of Masinloc, the range appears to be composed of coarse-grained orthopyroxene gabbro which, as observed in road cuts, is coarsely banded. The banding strikes north-south, approximately parallel to the trend of the range, and commonly dips from 30° to 60° to the east. Both gabbro and diorite surround large masses of serpentinized peridotite in the vicinity of the great Masinloc refractory chromite ore-bodies, and fine-grained gabbro and diorite dikes cut both ore and serpentine country rock. The serpentine bodies therefore may have been much larger at one time and, during the gabbro-diorite igneous cycle, were broken and separated into smaller masses, which even yet are one to several miles across. The relationship of the later gabbro and diorite to the aformentioned banded gabbro requires additional study.

At the latitude of Santa Cruz, fifty kilometers farther north, the western side of the range is composed largely of serpentinized peridotite extending to a short distance east of the Acoje metallurgical chromite mines. In this area the serpentine intrusive is more than 12 kilometers wide. The eastern part of the range is reportedly composed of gabbro and probably diorite. On the Acoje mine road near a limestone quarry at the base of the range, a reddish, iron-stained, intensely fractured, siliceous rock, which appears to be ferruginous chert, is exposed. This is the only known occurrence at present of pre-intrusive sediments in the Zambales Range.

In 1912, Fanning (1912) undertook a rapid reconnaissance of the northern end of the range where it descends to sea level. Peridotite was observed on Portuguese Point near Sual. Gabbro was found in abundance from Sual northwestward and also south of Barlo; it was classified microscopically as hypersthene gabbro or norite. Syenite appearing "to occupy a position between granite and diorite" was reported in the same areas. Granite also is reported outcropping over small areas near Pao Bay, and on Balincaguin River, 5 kilometers south of Barlo. Fanning made no attempt to describe the geologic relations of these igneous formations to one another, or to the country rocks which they must have intruded.

The basement rocks of Zambales Range, therefore, are seen to be one known small area of metamorphosed, pre-intrusive, sedimentary rocks near Santa Cruz, but mainly of intermediate to ultra-basic igneous types. Small areas of acidic plutonites occur at the extreme northern end of the range. Only when detailed regional mapping is undertaken will it be known whether the igneous sequence represents one or more intrusive cycles. The largest refractory and metallurgical chromite deposits of the Philippines and several small copper prospects, probably related to the gabbro-diorite magmatic sequence, occur in this largest known area of peridotites in the Philippines. The oldest dated Tertiary sediments overlying these rocks are lower Miocene.

SOUTHERN LUZON

Tayabas Isthmus.—Two areas of basement rocks crop out in the Tayabas Isthmus area of southern Luzon, one along the northern coast from west of Atimonan to the Santa Lucia River, the other bordering the south coast between Pinacapulan Point and Pitogo and extending inland 5 to 6 kilometers.

The northern area is reported by Birch and Merchant (Corby, 1940) to consist of coarsely crystalline diorite, which is locally intensely fractured and filled with quartz veins. Patches of green (chlorite?) schist are present. Altered green basic lavas, some serpentine, and gray schists (phyllites?) of northwesterly strike are found along the coast northwest of Atimonan. Similar rocks are reported on the northern side of the long, narrow Alabat Island to the northeast. The relationship of the various types to one another is not stated.

The southern area, according to the same author, consists of coarsely crystalline diorite. Unlike the northern area, the basement diorite is little sheared, and gneissoid structures are absent. The overlying metamorphosed Quezon formation of Oligocene (?) age appears to be similar to beds described by Pratt on the Caramoan Peninsula.

The oldest unmetamorphosed Tertiary rocks in this area are the Tayabas limestone (lower Miocene) which crops out south of Summit and along the coast southeast of Atimonan. The formation rests locally on schist, gneiss, and on volcanics. A small inlier of limestone grit overlying volcanics along the axis of the Pitogo anticline, and lithologically similar to the Tayabas limestone, yields the Eocene orbitoid, *Camarina*. This appears to be a still older unit which is buried beneath the widespread Miocene sediments.

Paracale District.—Immediately before the war, geologists of the Philippine Bureau of Mines under the direction of W. Benjamin Meek (1941), conducted a detailed geologic study of the Paracale gold-mining district.

The oldest known rocks in this district are serpentinized peridotites. The country rocks into which the peridotite must have intruded are not recognized. Approximately 8,000 feet of lower Miocene shales, arkosic and graywacke sandstones, conglomerates, and minor limestone beds, are interpreted by these geologists as deposited across the eroded surface of the peridotites. These rocks were intensely folded along northwesterly trending structural axes, and intruded by amphibole diorite probably in middle Miocene time, and by basalt and andesites extending, it is suggested, in the Pliocene. The Tertiary sediments were thermally metamorphosed by the diorite intrusives which also were the ore bringers for the iron deposits of Larap Peninsula, Calambayungan Island, and the Agusan Iron Mines east of Batobalani. During the Pliocene and possibly extending even into the Pleistocene, the gneissoid biotitic Paracale granodiorite, Meek believes, entered mainly as a domal intrusive into the peridotite rocks and crops out now as a west-northwesterly trending, oval-shaped stock. The rich gold veins of the district are contained mainly in fractures and fissures of this latest intrusive. Regional stresses and possibly intrusive pressure imposed a compact schistose structure upon the serpentine immediately along the contact and a gneissoid structure that boxes the compass within the granodiorite. Some sediments along the southern and western margins of the granodiorite intrusive are reported to be granitized.

These geologists state that although the basal peridotites may be very old, they can be identified as only older than the lower Miocene sediments deposited across them. Other investigators who have reported peridotite cutting even younger rocks in this area appear to have confused peridotite with basic volcanic rocks and other basic dike-intrusives.

It is significant to note the youthful age Meek attaches to the intrusives and to the metamorphism of the country rocks they invade.

With reference to the Paracale granodiorite, unless good evidence exists to the country, the present writer would be disposed to believe that its emplacement followed the intrusion of the iron-ore-forming diorite, as part and parcel of the same igneous cycle. The development of the gneissoid structure in the granodiorite seems to suggest that it too may have been emplaced during a late stage of the middle Miocene orogeny.

Southwestern Coast.—Basement rocks crop out along the coast between Panganiran and Pantao, opposite Burias Island, consisting Birch reports (Corby, 1940), of "basic rocks and metamorphics" intruded by later diorite. Between Cabarian and Malacbalac, the rocks are described as highly veined and fractured serpentine.

Caramoan Peninsula.—The rocks of this relatively inaccessible area were described by Pratt (1915). The mass of the peninsula, Pratt states, consists mainly of metamorphic rocks, including "talc and mica schist, schistose massive rocks, and marble". The schists are considered to be of sedimentary origin. The planes of schistosity are parallel to the bedding planes and though the beds are strongly crumpled and distorted, stratification is rarely obliterated. Stratification and schistosity strike west-northwest.

Pratt defined and measured the following partial section along a stream flowing into the Lagonoy river is the vicinity of Sabang:

Strata	Approximate thickness in meters
Green schists: imperfectly bedded, compact, hard rocks	200
Fine-grained marbles; homogeneous, grey to white	20
Thin fissile beds of talc-schist, schistose shale, and micaceous schists; green, yellow, and brown, with quartz lenses along bedding planes	500
White and blue marble	2
Fissile beds of schists like above, but gradually passing into schistose, massive, light green or blue clastic rocks	800
White marble	5
Massive schistose fragmental rocks; light green to blue	Undetermined

Under the sub-title "Correlation", Pratt states:

> "The metamorphic sedimentaries exhibit a succession of beds identical in its main features with the Philippine column of Tertiary sedimentaries. The observed sections in the metamorphosed sedimentaries and in the unchanged sedimentaries further east are similar, although the lower part of the metamorphosed section is developed in greater

thickness than the corresponding division of the unchanged rocks. Moreover, in ascending the Caramoan river, one passes gradually from unchanged sedimentaries to metamorphosed sedimentaries: that is to say, there is an evident transition from one formation to the other with no definite line of contact."

Pratt reports peridotite along the south coast of the peninsula at the base of the sedimentary rocks. Near Guijalo and Parucban fresh diorite forms the basement whereas on adjacent islands gneissic diorite seems to predominate. Hornblende diorite also was found in the vicinity of Mapid and around Tambang Bay on the north coast. On the east coast of Tambang Bay, a continuous exposure of a rock believed to be peridotite was found.

It thus appears that the plutonic igneous complex forms the basement to the metamorphosed sediments. Dynamothermal metamorphism converted the sedimentary rocks of the central and western parts of the peninsula to schists, leaving the sedimentaries at the eastern end unmetamorphosed.

The discovery of Tertiary sediments, thus metamorphosed, on the Caramoan Peninsula and in the Paracale district, and possibly in the Baguio area, points the question whether other crystalline schists in the Philippines might be of Tertiary age, and introduces the cartographic problem whether Tertiary crystalline schists should or should not be considered as part of the basement.

Southeastern Albay Province.—The basement rocks of Cagraray and Batan Islands acording to Birch and Merchant (Corby, 1940) are serpentine, and appear to be brought up by slicing along strong northwesterly trending faults. Judging from the number and distribution of its outcrops, serpentine probably has considerable areal extent beneath the Tertiary cover. The oldest dated formation in this area is the Sula limestone, of Eocene age. The somewhat metamorphosed and older Libog volcanic series is believed by these authors to overlie the serpentine basement, but this relationship has not been clearly established.

Rapu Rapu Island (Irving and Cruz, 1949), east of Batan Island, is comprised of three distinct rocks group of greatly different ages. The eastern two-thirds is underlain by strongly foliated epidote-feldspar-chlorite schist which is intruded by a gneissoid hornblende metadiorite that also injected the schist locally to form banded injection gneiss. The foliation of the schist strikes N. 45° to 60° W., and in the southern part of the island dips steeply southward, while along the north coast it dips gently northward. Some of the schists units are clearly of sedimentary origin, but their uniform basic composition indicates that many of them are probably derived from basic volcanics. This older group appears to be the product of an early orogeny, and in turn is intruded by an augite-enstatite peridotite which underlies the western third of the island. The peridotite in turn is intruded by small masses of eugranitic hornblende diorite. These latter intrusives probably represent a second magmatic cycle during which compressive stresses were inoperative. The basement rocks are overlain by small patches of Miocene limestone and sandy calcareous tuff which dip away from the topographic axis of the island as if they had arched over the island during its recent uplift.

LUBANG ISLAND GROUP

The Lubang island group comprises several small islands about 85 miles southwest of Manila; the principal islands are Lubang, Golo, Ambil, and Cobra.

The high interior of the larger Lubang Island, from geologic studies near Looc Bay and judging from boulders in streams descending from the northern slopes, is composed mainly of thin-bedded, crenulated, dark-gray, phyllitic schist that contains occasional thin horizons, 3 to 12 inches thick, of impure quartzite. These rocks are strongly folded along northeast to east-west axes in the Looc Bay area, and are intruded, on the peninsula east of Looc, by a cream to buff, coarsely crystalline, biotite granite which by weathering and by wave action forms excellent commercial quartz-sand deposits along the beaches. A zone of hybrid rocks, several hundred feet wide, is found along the intrusive contact south of Looc. Numerous narrow quartz veins occur on the country-rock side of this hybrid zone. Similar schist, hybrid rocks, vein-quartz, and granite, as well as granodiorite and diorite, are represented among the river gravels along the northern base of the range between Tilic and the town of Lubang.

From a trip along the coast by boat, Smith (1924, p. 259) reported serpentinite near the barrio of Viga on the eastern coast of Lubang which may be related to that of Ambil Island across the channel. The entire island of Ambil appears to be composed of this rock.

Smith reported that the north and south side of Golo Island is composed of schist similar to that of Looc Bay, but the central part of Golo is underlain by serpentinite. Granite is reported by the same author on the northern part of Maricaban Island.

The basement rocks are overlain by young coral reaf deposits on the northern and western plains of Lubang. No Tertiary sediments have been reported.

MINDORO ISLAND

The central part of Mindoro rises to elevations exceeding 8,000 feet, and is composed mainly of basement rocks. Although gold-quartz veins have attracted prospectors in the northern part, and gold placers occur along several mountain streams including the Tanibay and Binabay Rivers, the interior of the island is little known.

Smith (1924, p. 257) states that schists, similar to those of Lubang Island, crop out along the northern side of the island. He also reports that rock specimens secured by Dr. E. D. Merrill from the summit of Mt. Halcon, the highest peak of the island, were identified by himself as andesite.

Teves (1937), in describing the geology of the Puerto Galera area of northern Mindoro, found chloritic and calcitic schists, biotite-feldspar gneiss, and marble intruded by small serpentine masses along the coast, and by large bodies of flesh-colored biotite-hornblende granodiorite in the highlands back of the port. The basement rocks in the coastal area are overlain by Miocene and younger shales, sandstones, and by recent coralline reef limestone. Teves is probably correct in stating that Mount Halcon is composed mainly of basement rocks, although volcanic types, as stated by Smith, may be also present.

Dean Frasché is reported by Corby (1940) to have identified granite, granodiorite, diorite, gabbro, peridotite, serpentine, schists, cherts, and slates, among the rock types in the basement.

Probably the most striking feature of the geology of the island is the discovery by J. S. Hollister, geologist for the National Development Company, of the first and only known ammonites in the Philippines. The ammonites were first collected from beds exposed near Colasi Point south of Mansalay Bay, southeastern Mindoro. Other specimens were found in limestone concretions as float along rivers emptying into Mansalay Bay. Hollister (Corby, 1940) states that back of the coast from Mansalay, eastward dipping sediments, several thousand feet thick and consisting of unfossiliferous hard calcareous mudstones, and calcareous or siliceous carbonaceous sandstones, may be of the same age. The sediments of this section seem to be somewhat finer grained, however, than those near Colasi Point where a coarse conglomerate is associated with the ammonite-bearing beds.

De Villa (1941) collected a suit of ammonites from the above localities and identified the following species: *Phylloceras* sp., *Perisphinctes taliabuticus* Boehm, *Perisphinctes tignoani* n. sp., *Perisphinctes mansalayi* n. sp., *Opella* (Newmayria) sp., *Hammatoceras Moluccanum* Cloos, *Macrocephalites* sp., *Perisphinctes Komodoi, Perisphinctes Sularcum* Boehm, *Perisphinctes tiziani* Oppel. These fossils, whose identifications probably require review, led de Villa to assign a middle to upper Jurassic age to the beds.

The Mesozoic beds have a northeasterly trend whereas the Tertiary beds have a more northwesterly trend; the Mesozoic rocks are said to be little more deformed than the Tertiary rocks. It is suggested by Corby that Mindoro, like Palawan, may be a part of ancient Sundaland.

Feliciano and Basco (1947) re-studied the Mansalay area and they reported that on Wasig Creek, approximately 10 kilometers north of the town of Mansalay, the Mansalay sediments are intruded by serpentine, gabbro, and diorite, probably in that order, which converted the black shales to hornfels, black slate, and silicified shale, and at one point may be responsible for the formation of auriferous quartz veinlets as fracture-fillings. If these observations are correct, at least two orogenic cycles are represented, one in the rocks of the pre-Jurassic basement, the other involving the Jurassic sediments. Possibly a third oroganic disturbance is represented in the deformation of the overlying Oligocene Bandao and the lower Miocene Bulalacao limestones.

ISLAND OF MARINDUQUE

Marinduque, a nearly circular island that lies northeast of Mindoro and midway toward the Bondoc Peninsula of southeastern Luzon, is traversed by a north-south mountain range which divides it into two nearly equal parts.

The island was first visited by the geologist, Maurice Goodman, in 1907, and his manuscript report is quoted extensively by Smith (1924, pp. 148–152).

Goodman states that the basement rocks of the island are composed of diorite, which in places grades into quartz diorite. In some places, he states, "notably in the south-western part of the island, are immense serpentine and chloritic outcrops which resulted from the alteration of the most basic igneous rocks. These rocks have in places become so squeezed and shattered as a result of metamorphic processes to cause them to take on a felsitic texture, and to develop a marked cleavage structure". Quartz veins, some containing gold, copper, lead, and zinc, fill fractures in the igneous rocks at several localities.

In the gorge of Maculapuit Creek, a tributary to Boac River, Municipality of Mogpog, hematite ore bodies of the Gold Star Mining Company, are reported by Frasche (1940, p. 26) to be of contact-metamorphic type, occurring along the contact between diorite and quartzite (metavolcanics, E.M.I.).

Corby (1940) reports that diorite and serpentine predominate among the basement rocks but other basic intrusives also are present. Although the relations are not always clear, diorite appears to intruce the more basic types. Stray inclusions of marble, possibly related to the marbles of Mindoro to the west and of Tablas and Romblon Islands to the south, are occasionally found in the serpentinite. Some of the Tertiary limestones are crystalline and deformation has imposed a slaty structure upon some shales and siltstones. Serpentine appears to pierce the Catala marble of middle Miocene age, possibly in diaper structure, while near Gasan, a reverse fault brings serpentine against the Boac formation of late Miocene age.

The basement rocks are overlain by steeply dipping Tertiary sediments and interbedded volcanics, the oldest of which is the Torrijos formation of upper Oligocene to lower Miocene age.

ROMBLON, TABLAS, AND SIBUYAN ISLANDS

Romblon, Tablas, and Sibuyan Islands and their islet cortege form a small group lying north of Panay and about midway between the islands of Mindoro and Masbate.

Adams (1909) published a brief note on the rocks around the port and town of Romblon on the northern coast of Romblon Island. A fine-grained and thoroughly crystalline marble near the town strikes N. 30° E. and dips about 30° to the west. It varies from pure white, to mottled and streaked varieties in gray, bluish, greenish, or brownish tones. The marble is overlain on the west and underlain to the east by yellowish to gray micaceous and siliceous schists which are transected by occasional quartz veinlets. Adams regarded both rocks to be of metasedimentary origin. The marble provided the basis for a polished-stone industry before the war.

Hollister (Corby, 1940) reports that similar schists are extensively exposed in southeastern Tablas and appear to be intensely deformed sediments with regular bedding. Marble is widely distributed around the northern end of Romblon, Alad, and Tablas Islands and on Cobrador Island north of Romblon. Scattered patches of marble are found also along the eastern coast of Tablas. The extensive outcrops of marble on the northern ends of Romblon, Alad, and Tablas Islands, according to Hollister, appear to represent northerly plunging anticlinal structures in the metamorphics. The oldest unmetamorphosed formation overlying these rocks is the Bagolinao limestone of middle Miocene age.

The western side of Sibuyan Island rises with sheer slopes to a single summit, Mount Sibuyan, whose elevation exceeds 6,000 feet. Smith (1924, p. 200) regarded this mountain as a volcanic stock. The vegetation of the upper part, as seen from the air, is unusually sparse despite the heavy rainfall it receives. Because it lacks the configuration of a volcanic structure, and has sparse vegetation, it is possible that the region may be underlain by serpentinite, at least in part.

ISLAND OF MASBATE

In describing the geology of the well-known Aroroy gold mining district of northwestern Masbate Island, Ferguson (1911) distinguishes two groups of rocks in the basement: (1) the sedimentary Kaal formation, and (2) the Aroroy quartz diorite. The Kaal strata consist of fine-grained, red and dark purple slates and occasional interlaminated layers of siltstone and graywacke. The beds are considerably contorted and metamorphosed, strike northeasterly, and dip steeply to the northwest. The hornblende quartz diorite intrudes the Kaal formation and although cropping out over only a small area in the extreme northern part of the Aroroy district, it widens extensively eastward forming the principal rock underlying the area between Guinobatan River and Magdalena Bay. Individual outcrops yield specimens that are found under the microscope to include diorite, syenite, and gabbro. Due to heavy overburden these various types could not be resolved into separate intrusives, and, accordingly, were tentatively included with the Aroroy quartz diorite formation.

Ferguson states that "Little can be said as to the absolute age of the Kaal formation. No fossils have been found, but judging from its position, its extreme contortion and considerable metamorphism, it is my belief that it may be classed provisionally as pre-Tertiary, the earliest Miocene shales of the Port Barrera formation". Several words are evidently missing following the comma after "pre-Tertiary" but it is understood from the context that the Port Barrera formation (Miocene) is the oldest overlying formation.

As a result of mapping by Robert Reed, Corby (1940) reports that the basement complex of eastern Masbate has the same aspect as in western Masbate. "It varies from a massive, chocolate-brown, fine-grained rock, usually bedded and jointed, to a dark porphyritic rock; associated with it are plentiful tuffs and pyroclastics. Cherts are also present. These rocks are often fresh-looking and may be Tertiary in age".

BALABAC-PALAWAN-BUSUANGA ISLAND GROUP

The geology of this northeasterly trending island chain is probably the least known of the Philippines, yet because, like the Sulu Island group, it links the Philippines with the mainland of Borneo, its geologic and tectonic history may have considerable significance in the proper understanding of the origin and history of the archipelago. The basement geology of each island as it is known will be described beginning with the southernmost, and proceeding northward.

Balabac Island.—In 1913 R. A. Rowly visited Balabac island and collected various rock specimens. Among these Smith (1924, p. 249) found cherts in which he was allegedly able to identify radiolaria of Jurassic age.

During recent investigations (Irving, 1949), the east-central highland part of the island was observed to be composed of highly folded and twisted, dark red to chocolate colored, ferruginous shaly limestones which contain quite regular and persistent ferruginous chert layers, 2 to 6 inches thick, which are separated by as much as 1 to 6 feet of limestone. The shaly limestone evidently became contorted by the mechanism of plastic flowage. The interleaved cherts layers, on the other hand, failed so completely by fracturing that it is difficult often to obtain hand specimens larger than small angular fragments. The fractured cherts are usually partially healed by later calcite veinlets and fillings, and occasionally by pyrolusite veinlets.

Along the eastern coast of the island the shaly limestone and fractured chert sequence is associated with strongly fractured, and somewhat metamorphosed (chloritized) volcanics of basaltic composition. Elsewhere the sediments and the volcanics are intruded by small bodies of serpentinized enstatite peridotite and by coarse-grained gabbro, specimens of which possess a remarkably fresh aspect. Around the southern, western, and northern sides of the island the basement rocks are overlain by lower Miocene siliceous sandstones and pebble conglomerates, with interbedded dark gray organic shales. This sedimentary sequence has been thrown into steeply dipping northeasterly-trending folds. Younger faults appear to have been important in delineating the distribution of formations as well as determining the present topography of the island.

The contrasting composition of the shaly limestones and interbedded siliceous cherts, both of which are quite ferrugineous and somewhat manganiferous, seems to require special explanation. Because these sediments are in addition associated with volcanics, it has been suggested that the sediments are of deep sea type, in which submarine volcanic springs may have contributed silica to the formation of the cherts. Under the microscope, the cryptocrystalline chert is observed to contain occasional small, sharply defined, round areas of micro-crystalline quartz which may represent recrystallized tests of radiolaria, although this could not be established. No unaltered or partially altered radiolaria could be found. At any rate, the suite resembles certain facies of the Danau formation, described as Jurassic (Molengraaf, 1902), Triassic (Umbgrove, 1938), or Carboniferous (Zeijlmann van Emmichoven, 1939), and which reportedly occurs on Banggai Island, Northeast Borneo, 30 miles to the south.

Palawan Island.—At San Antonio Bay on the east coast, southernmost Palawan, McCaskey (Smith, 1924, p. 251) reported quartz and red jasper (chert?) among the pebbles along the beach, and in the hills to the southwest, "beds of decomposed red slate and . . . . . rhyolite, or quartz trachyte".

During a recent brief visit at the port of Brookes Point by the present writer, the pebbles at the mouth of a large river that descends from the central cordillera and passes across the broad eastern coastal plain, were seen to comprise such various types as red ferruginous chert; gray, micaceous, thin-bedded and somewhat schistose quartzite; silicified phyllite containing interleaved quartz veins along the schistosity; light-and dark-green serpentinite, coarse-grained granodiorite (ballast?) very similar to Hongkong granite; and a variety of volcanic types some of which are metamorphosed. With field binoculars (x10) the central cordillera is observed to consist of rugged angular topographic forms alternating with local areas of smooth profile and less vegetation, which, together with the pebble information, suggests the presence of a metamorphic terrain intruded by peridotite or serpentinite.

On the trail from Separation Point across to Alphonso XIII on the west coast, south-central Palawan, McCaskey (Op. cit.) reported that quartz and jasper are again found in the streams. Across the bay from Puerto Princesa, on the flanks of Mt. Pulgar, he reported a coarse-grained biotite hornblende diorite containing variable amounts of free quartz. In northern Palawan, on the trail between Malampaya Sound and Taytay, and around Taytay itself, he found "siliceous rocks and quartzites." At Malampaya Sound, McCaskey confirmed the statement made by Commander W. T. Bate of the British Navy in 1851, that Mt. Kapoas is composed of granite. From sands along the beach he deduced that the rock was probably a biotite granite.

In 1913, Rowley spent several weeks mainly in the vicinity of Taytay, northeastern Palawan, and submitted a collection of rocks which according to Smith include: diorite, chlorite schists, graphitic schist, talcose schist, slate, serpentine, quartzite, chert, and younger unmetamorphosed sediments.

E. M. de Villa (1941) spent two months on Palawan and is the first to present a reconnaissance map of the island. At the small village of Gulang Gulang, near Mt. Kapoas on the south end of the already mentioned Malampaya Sound, de Villa found a dark, iron-gray, dense rock that separates into thin parallel layers like a roofing slate to which he assigns the formation name, Gulang Gulang slates. The comparatively undisturbed and homogeneous slates, with beds varying from 20 to 30 feet in thickness, strike N. 30° to 70° W., and dip uniformly 40° to 60° north. The formation is said by de Villa "to lie upon some schistose rocks, chlorite-, graphite-, and talc-schist, the junction appears to be conformable" (?). De Villa states that the formation is metamorphosed by the Kapoas granite which intrudes it. With no fossils, and upon the basis of lithologic similarity to the "old slates" of Borneo, and to slates associated with the ammonite-bearing shales of Mindoro, he assigns, questionably, a lower Jurassic age to the formation. These rocks in turn are overlain by shattered quartzites.

The biotitic Kapoas granite, de Villa states, crops out in addition east of Bacuit, west of Aborlan in the south-central part of Palawan, and on the island of Linapacan northeast of Palawan. The rock is commonly pale gray, fine-grained, and contains abundant quartz. Peridotite also was reported to crop out extensively west of Puerto Princesa, and gabbro associated with peridotite near Baheti, Bentoan Bay. The age of the peridotite and gabbro with respect to the granite is not given, nor the age of the orogeny, or orogenies, implied by their emplacement.

Eocene limestone at Maytiguid Island, and highly folded lower Miocene limestone north of Puerto Princesa, overly the foregoing basement formations.

Linapacan Island.—The Linapacan metamorphic series, as termed by de Villa, crops out on northern Palawan, on Linapacan, and on Culion and Busuanga Islands to the north. De Villa describes the series as it occurs on Linapacan Island, to consist of: (1) an underlying agglomerate containing large boulders of pure white quartz and manganese and iron-stained blocks of Kapoas-type granite near San Miguel, Linapacan; (2) an overlying unit, unconformable, of 20 meters of apparently rhythmically stratified, laminated quartzite, whose laminations vary in thickness from a few millimeters to 2 or 3 centimeters, and which sometimes are separated by thin clay partings; and (3) an overlying unit of coarsely stratified massive, compact, yellow quartzite, 30 to 40 meters thick. On Linapacan Island these sediments are said to be relatively flat-lying, but on Busuanga Island they have high dips. The sequence is regarded by de Villa to be of upper Eocene age on the basis of Himalayan-Malayan peninsula geology (!). No fossils are mentioned. The above-mentioned rocks are overlain locally by middle Miocene limestones and younger sediments.

Culion Island.—Smith (1924, p. 254) quotes from a manuscript by McCaskey that in sea-cliffs below the town of Culion, Culion Island, he observed "a continuous exposure of highly metamorphosed, twisted and contorted, and occasionally faulted, quartzites." The quartzite is light yellow, varying to pink, and, at one outcrop where a thickness of about 18 meters was exposed, 160 thin but distinct laminae were counted. From a trip around the island by boat, with brief observations at several points, the island, according to McCaskey, appears to be composed mainly of thin to thick-bedded quartzites containing interlaminated and interbedded argillites. Thus far, attempts to determine the age of these rocks have been unsuccessful.

Busuanga Island.—On the southern coast of Busuanga, McCaskey found outcrops of highly siliceous rock that appeared identical with the quartzites of Culion. From mining operations it is known that Busuanga is composed entirely of highly folded, thin-bedded quartzite and chert of unknown age.

PANAY ISLAND

Much that is known of the basal rocks of Panay results from the work of the Spanish geologist, Enrique Abella y Casariego (1890), between 1886 and 1890.

The island of Panay is roughly triangular in form, bounded on the west by a youthful cordillera, trending north-south, and composed mainly of crystalline rocks, and on the east by a lower, northeasterly trending mountainous cluster composed of similar rocks. A belt of basement rocks connects the two cordillera across the northern part of the island. Between these unequal diverging cordillera, the basement formations are overlain by an almost complete section of middle and upper Tertiary sediments said by Pratt to be 9,000 meters thick. The Tertiary sediments are flexed into a broad syncline which plunges gently from a low northern divide southeastward toward and beneath the Iloilo plain.

The basement rocks of the western cordillera are composed of thin-bedded siliceous cherts which are interbedded with metamorphosed volcanics, some of which retain pillow structures. These rocks are cut by various igneous intrusives. Abella y Casariego listed the following igneous types from the cordillera: picrite (olivine, augite, bronze hypersthene), serpentine, gabbro diorite, quartz diorite, tonalite, andesite, basalt, diabase, and trachyte. Picrite was reported on Rio Tigpuluan near Amayon, Sibalom, and at Anini, Antique Province, and on Mount Sinalman, Miagao, Iloilo Province.

Serpentine also is found on Punta Mabgaran, Tangalan, Capiz Province; on the island of Pan de Azucar, and at Concepción, Iloilo Province. Diorite and quartz diorite occur in a number of localities in Capiz and Antique Provinces, and gabbro at several points in Iloilo Province.

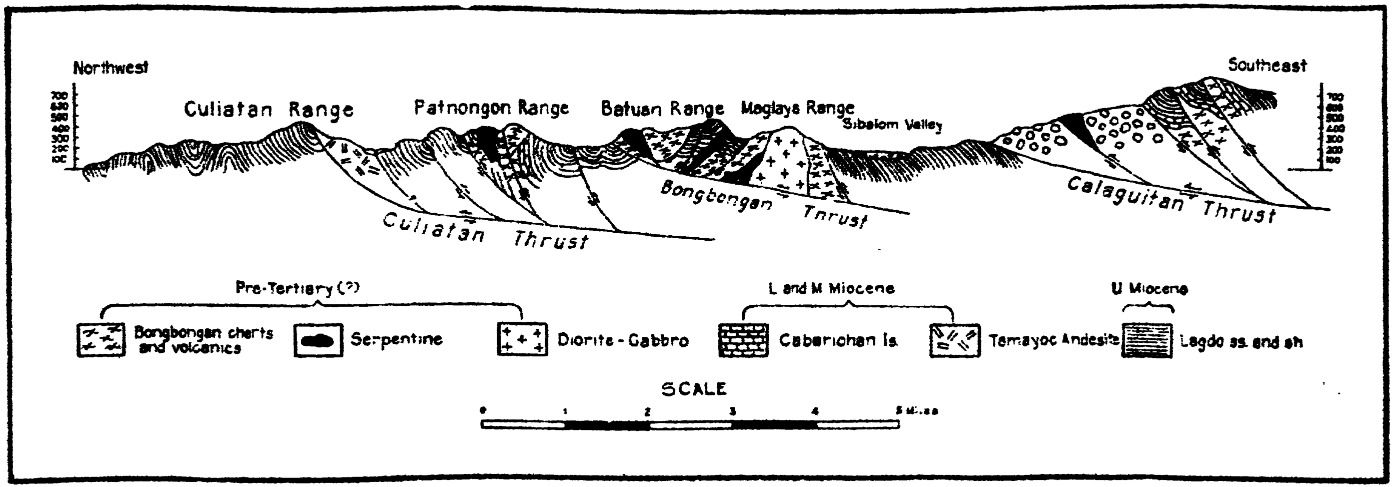

FIG. 3. Northwest-Southeast geologic section from near Patnongan, through Bongbongan, to and beyond San Remigio, Antique Province, Panay (by Luis Santos Yñigo, 1949).

Near the headwaters of the Ulian River in south-central Panay, at an elevation of 1,000 feet, Smith (1915) found indurated sediments resembling slate which are intercalated by diorite sills 3 to 5 meters thick. At another locality in the same area is found a "blue-black, very dense, exceedingly fine-grained rock" with conchoidal fracture that possesses a fine sedimentary banding. Because its partings were not typical of a slaty cleavage, Smith called it for want of better term, pseudoslate. He found also a reddish, fissile, siliceous, jasper-like rock, similar to that of Ilocos Norte on Luzon, in which he states he was able to identify the radiolaria: *Stylosphera* sp., *Dictyomitra affina*, *Cenosphaera minuta*, and *C. disseminata*. These fossils lead him to assign a Jurassic age to the sedimentary rocks.

On the Buruanga Peninsula of northwestern Panay, Luis Santos-Yñigo reports (personal communication) mica-quartz schist which contains interbedded coarse-grained marbles. Both strike N. 30° W., and are intruded by a flesh-colored biotite diorite.

During recent examination of the copper-pyrite deposits of southern Antique Province, Santos-Yñigo (1949) discerned extensive thrust-faulting and for the first time conclusively established its existence in the Philippines. Thrusting has caused intimate imbrication of basement formations with Tertiary sediments (See Fig. 3). The oldest formation recognized in the Bongbongan and San Remigio cooper mines area, located northeast of San José, consists of thermally metamorphosed basaltic lavas with interbedded manganiferous cherts, and occasionally, green clastic sediments. Pillow lavas are abundantly represented, suggesting that many of the erruptions were submarine. The metamorphics are intensely folded along NE–SW axes, and are intruded by strongly serpentinized peridotite, by local masses of gabbro containing gabbroic pegmatites, and by possibly two generations of diorite. In the late Miocene, strong compression from the southeast caused low angle thrusts to develope, and resulting that successive plates of basement became sandwiched between belts of strongly deformed lower Miocene limestones and andesites, and upper Miocene sandstones and shales. Late Miocene deformation appears to have followed the same trend lines of the basement rocks, resulting that the regional geology now has strong northeasterly lineation. It is presumed that the basement of this area is of pre-Tertiary age. Radiolaria in the cherts must await competent identification.

NEGROS ISLAND

Santos-Yñigo and Oca (1946) reported about 3,000 feet of highly indurated, steeply dipping and tightly folded shale, sandstone, and quartzite with local cherty and manganiferous horizons, in the area of Kabankalan, south-central Negros Occidental Province. The principal axes of folding trend northeast to southwest and this formation is unconformably overlain by Miocene coal-bearing formations. The authors suggest that on the basis of lithologic similarity these highly indurated sediments may be equivalent to the Cretaceous (?) Pandan formation of Cebu. As lithology alone is a weak field criterion for correlation of formations over great distances this possible correlation requires additional field data.

The copper deposits of Sipalay in southwestern Negros are reported by Santos-Yñigo to occur in a considerably altered quartz diorite whose age has yet not been established.

CEBU ISLAND

Cebu is a mountainous shoe-string island, trending north-northeast, in the geographic center of the Philippine archipelago. Basement rocks crop out in the north-central part forming the back-bone or core, as it were, of the island. A thick section of Miocene sediments directly overlying the basement formations is folded along northeasterly-trending axes and crops out extensively around the basement core. Southward they extend almost to the southern end of the island. Pliocene sediments unconformably overlie the Miocene sediments; these are arched into a broad anticlinal structure that determines the outline and present trend of the island. The superposition of the north-northeasterly elongated dormal structure of the Pliocene sediments upon the northeasterly trending folds of the Miocene sediments, complicated further by faulting (probably related to uplift), results that the intervening Miocene sediments now form an anticlinorium of complex structure between the basement formations and the overlying Pliocene sediments.

During the geological investigation of this island for petroleum possibilities, J. S. Hollister and E. Taylor (Corby, 1940) reported the occurrence of a highly contorted and steeply dipping sequence of crystallized and veined limestone, indurated

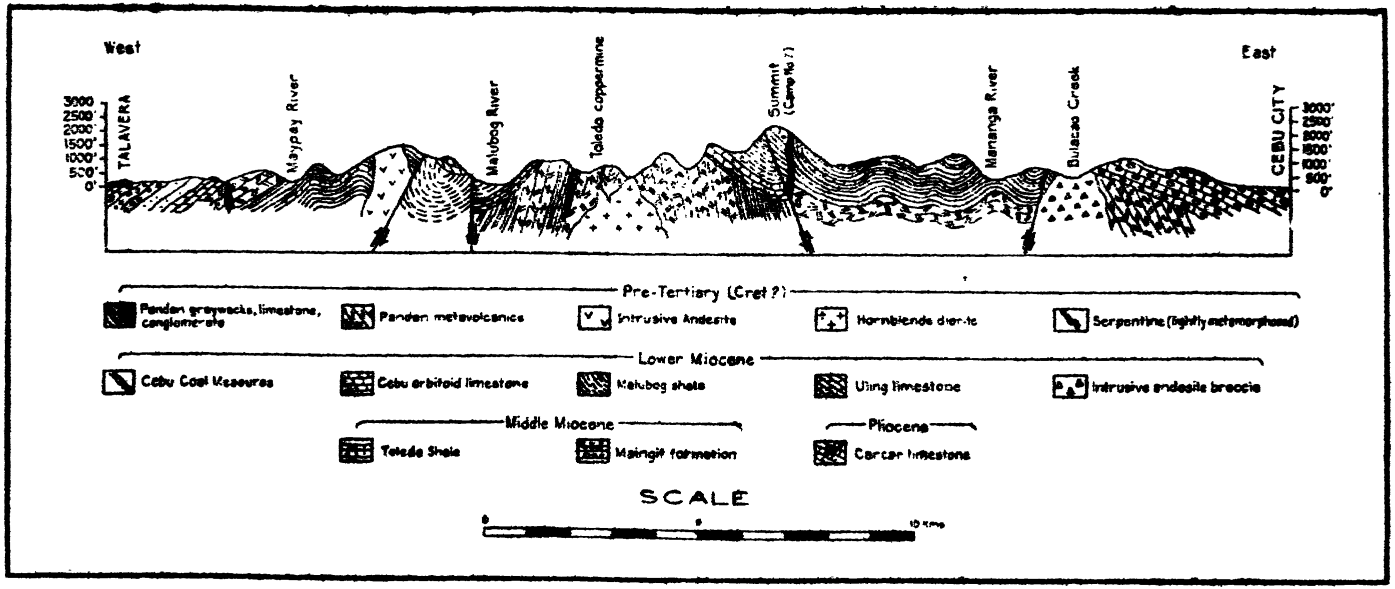

FIG. 4. East-west geologic section through Cebu Island at the latitude of the Tabunoc-Toledo road (by Luis Santos Yñigo, 1950).

shale, and conglomerate along the road from Naga to Uling, to which they assigned the formation name, Pandan. Similar rocks containing interbedded volcanics are exposed along the cross-island road between Tabunoc and Toledo. In a road-cut near kilometer post 24, the orbitoid *Orbitolina* was discovered in a prominent limestone outcrop. Although the single fossil was imperfectly preserved, this indicates that these rocks may be Cretaceous in age.

Recent geological mapping by Santos–Yñigo shows that similar rocks have broad aerial extent throughout the basement area. In places volcanics, varying from andesites to basalts, predominate; elsewhere sediments predominate. No structural breaks have been noted, accordingly the volcanics and sediments appear to be an interbedded sequence of probably considerable thickness. Some of the lavas possess well-defined pillow structures, suggesting that they represent submarine eruptions in part. The sediments and the volcanics show varying degrees of thermal metamorphism and propylitization; near intrusive contacts biotite hornfels, calcsilicate rocks, and epidote-rich recrystallized volcanics are common. Despite metamorphism, some of the limestones contain fossil remains and it is hoped that more data may be obtained regarding the precise age of the formation.

The Pandan formation is cut by several igneous intrusive types. The largest known body of serpentinized peridotite cuts volcanics of the Pandan near the summit of the Tabunoc–Toledo road, at kilometer post 26. Elsewhere serpentine seems to be confined to major faults, occurring as strongly slickensided blocks within larger fault zones. Occasionally coarse-grained hornblende schist, quartz albitite, and albitite impregnated hornblende schist are associated with such serpentine blocks; these may represent still older country rocks carried up along the fault zone. In several instances, these rocks have been transported such distances along faults that they lie between walls composed of Tertiary sediments.

In the vicinity of the Toledo copper mine, metamorphics of the Pandan type are cut by andesite porphyry bodies and these in turn by a slightly porphyritic diorite. The latter intrusive appears to have been the source of the copper, for the ore-body occurs within the older andesite porphyry. Near Malubog, metamorphics of the Pandan type are intruded by larger diorite masses.

The basement area of Cebu seems to present one of the best opportunities for downward penetration, geologically speaking, into the older geologic epochs of the archipelago, and warrants accordingly detailed and careful study.

BOHOL ISLAND

Basement rocks crop out in the northern part of the island. Southeast, south, and southwest of the town of Ubay, broad areas consist of serpentinized peridotite.

Corby (1940) reports that the basement complex consists of "an heterogeneous mass of volcanic flows, agglomerates, serpentines, intrusives, etc.". An intrusive plug of Tertiary age near Ilihan is said to be indistinguishable from the volcanics of the older rocks. South of Tubigon, in western Bohol, an intensely deformed sequence of volcanic rocks and sediments was found; it contains an Eocene fauna. The lower Miocene Wahig limestone cropping out in the gorge of the Wahig River overlies steeply dipping volcanic flows and agglomerate.

Thus, whereas some of the volcanics mentioned by Corby are undoubted Tertiary, others may be pre-Eocene. The age of the serpentine south of Ubay with respect to the older volcanics is not known.

LEYTE ISLAND

Basement rocks were first reported from Leyte by the German geologist, Fedor Jagor (Adams, 1909, p. 339) in 1860, when he observed grayish-green, chloritic schists near Tanauan, eastern Leyte. Adams visited the locality in 1909, and described a much squeezed and slickensided serpentine from a quarry one mile east of Tanauan.

From a private report by Ashburner, dated 1883, Becker concluded that basement rocks probably crop out on Panaon Island south of Leyte. Ashburner reported that gold prospects occur in a greenstone porphyry, which, according to Adams, might be a "diorite or a diabase". Adams discovered diorite and peridotite on the northern end of Panaon Island, near Liloan, and near Malitbog across the channel on the southernmost Leyte mainland.

Adams also reported a belt of sedimentary rocks north of Tacloban, which have been "metamorphosed into schists and altered shales by intrusive igneous rocks". Corby states that isolated hills along the eastern margin of the island as far south as Abuyog are composed of igneous rocks which are pre-Oligocene in age and form the tectonic core of the island. The overlying Tertiary sequence has general westward tilt away form this structural high.

Corby also reports that the central cordillera of western Leyte is composed mainly of Pliocene to recent volcanic rocks, but that they may be in part older basement rocks. Mt. Magsanga in northwest Leyte is said to be composed mainly of peridotites and basalt. These older rocks are stratigraphically overlain by the strongly folded lower part of the Taog formation, of upper Oligocene or lower Miocene age, which may have been brought up along the axis of an anticlinorium.

SAMAR ISLAND

Information regarding the island of Samar is sketchy. Much of the available published data originated from a reconnaissance trip across the island by H. G. Schenck and G. B. Moody in 1920, of which Schenck (1922) published a brief summary. Corby, et al, conducted brief studies on the southern and western coasts, and on the Daram Islands to the west.

Central and southeastern Samar is underlain by a great variety of rocks. During his cross-island traverse, Schenck found red to brown fragments of jasper and chert in the headwaters of the Ulot river, near Loquilocan, which led him to suspect that these rocks might be found in place, probably in the area near Lawaan, north of Loquilocan. Two kilometers downstream from Loquilocan, he found outcrops of a hard, fine-grained, compact, blue-gray rock, which in the field appeared to be quartzite, but microscopic study proved it to be a feldspar porphyry. Farther to the west, near Bagakay, the rocks, composed mainly of fine-grained, fractured volcanics, were found in considerable structural complexity.

Dean Frasche (1940, pp. 25–26) reported the following rock types associated with the iron deposits of Pambuhan Sur, southeastern Samar; andesite, basalt, gabbro, serpentine, garnet schist, quartz monzonite, diorite, and gneiss. In the immediate vicinity of the Samar Iron Mining Company, the outcrops consist of serpentinized basic rocks which are overlain by a "series of limestones, marbles, and metamorphosed clastics which dip to the west and southwest at varying angles." The iron deposits are said to occur at the base of the sedimentary series near the contact with the underlying igneous complex.

Corby believes that the volcanic rocks of central Samar form the basement core of the island. The higher grade metamorphic rocks noted by Frasche may be the older of two groups.

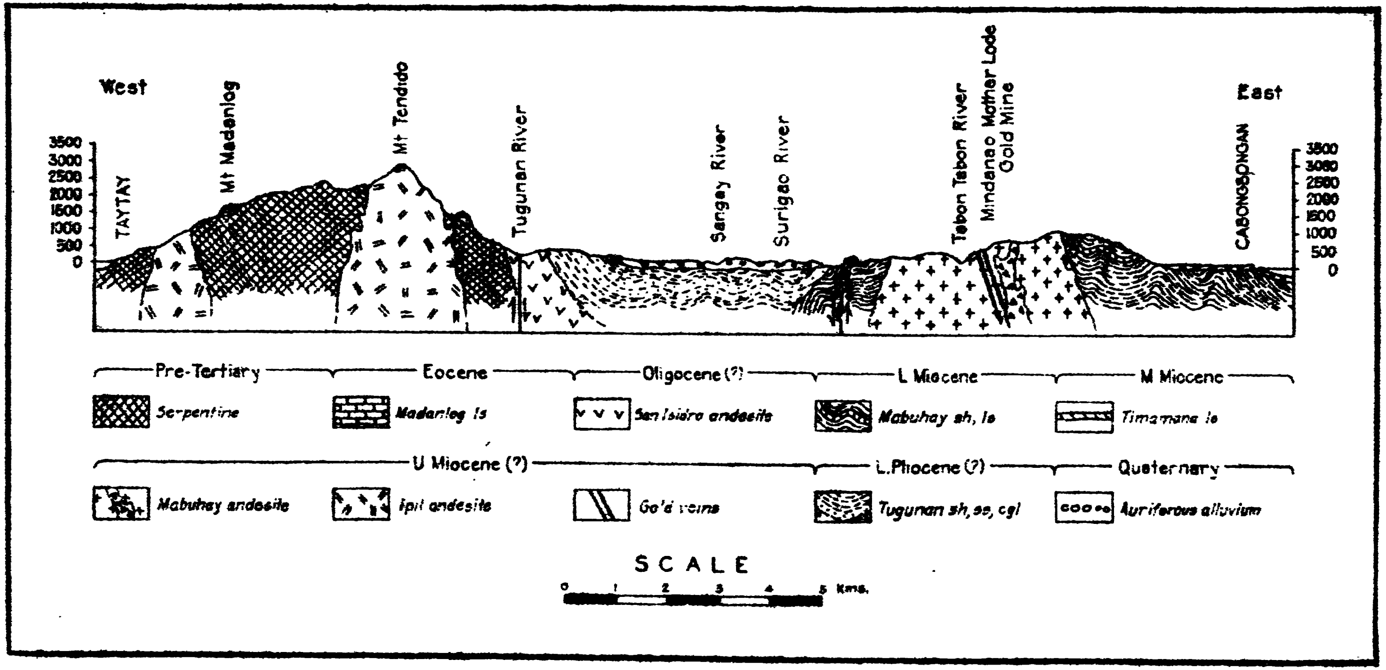

FIG. 5. East-west geologic section through the Surigao Peninsula at the latitude of the Mindanao Mother Lode gold mine (by Luis Santos Yñigo, 1949).

Chromite in serpentine is reported by Frasche (1939) on Calicoan Peninsula of southeastern Samar and on Homonhon Island off the southern coast.

ISLAND OF MINDANAO

Basement rocks crop out in three principal areas: along the eastern Pacific cordillera; as isolated patches in the central part of the island where they are exposed through windows or in deeply etched canyons in the superjacent Tertiary sediments and volcanics; and along the axis of the Zamboanga Peninsula to the west.

PACIFIC CORDILLERA

Northeastern Islands.—The islands of Dinagat, Bucas Grande, Nonoc, and Siargao, off the northeastern tip of Surigao Peninsula, northeastern Mindanao, were studied before the war by field parties under George H. Kemmer. These islands are underlain by serpentinized peridotite. Important chrome deposits occur on Dinagat, and large deposits of lateritic iron ores have developed upon the serpentine of Nonoc and Hinatuan Islands. Upper Tertiary sediments and Recent coral reefs fringe these islands and blanket a large area of Siargao Island.

Surigao Peninsula.—Just before the outbreak of war, Bureau of Mines geologists, under the direction of Mr. Robert Crump, executed a detailed geologic survey of the Surigao gold district. Though all maps and most of the field notes were lost during the Japanese occupation, Mr. Luis Santos-Yñigo (1944) prepared a separate interpretation of the geology of this area.

The oldest rocks of the Surigao Peninsula are composed of metamorphosed clastic sediments and limestones, known as the Sohatan formation, after Sohatan, a village on the western coast of the peninsula. The Sohatan formation is composed of metamorphosed conglomerate, sandstone, marble and schists characterized by various types of amphibole, including glaucophane.

The Sohatan formation has been strongly deformed along north-south fold axes. It is intruded over extensive areas by serpentine along the western range, and smaller areas of serpentine are found on the northern tip of the peninsula, along the Anao-aon River Valley, in the Cansuran placer district, and at Nabago near the northeastern coast of Surigao. Small, widely scattered, exposures of metamorphosed basalt, amphibolite, metadiorite, and metadacite also are reported.

Both the metamorphic rocks and the plutonic intrusives are overlain by the Mt. Madanlog limestone of Eocene age, and by younger Tertiary sediments and volcanics.

Dahican Bay-Cabadbaran Area.—The great lateritic iron-ore deposits of Dahican Bay and vicinity, 90 kilometers south of Surigao, were extensively investigated from 1937 to 1939 by geologists of the National Development Company under the direction of Mr. George H. Kemmer.

The lateritic iron ore deposits overlie a large serpentine mass that extends inland for a radius of more than 20 kilometers from Dahican Bay. Crystalline schists including gneisses, quartz and mica schists, and hornfels, similar to those described by Santos-Yñigo in the Surigao gold ditsrict are found in adjacent areas. There appears little doubt that the serpentinized peridotite of this area has similar intrusive relations to the country rocks as that to the north. West of Mount Legaspi serpentine is overlain by Eocene sediments.

Additional interesting features of the basement geology of this area reported by Kemmer are: eclogite (?) blocks and nodules enclosed in serpentine dikes; blocks of Eocene limestone enveloped and partly metamorphosed by serpentine; peridotite dikes reported to intrude Miocene sediments.

Despite controversies in the interpretation of these findings, the question whether there may be more than one general period of serpentine intrusion in the archipelago is open.

Goodman (Smith, 1924, p. 239) crossed the narrow range between Lake Mainit and the Surigao Sea and found chloritic schists; finely laminated, red and brown slates, in some places interleaved with marble; talc schists; and red jasper.

Central Pacific Cordillera.—Montano made a trip along the east coast of Mindanao and is quoted by Smith (1924, p. 238). In crossing the Pacific cordillera west of Bislig, he found the range at this latitude to consist of "Miocene andesites of great thickness". Between Bislig and Cateel, along the coast, he collected "madrepores altered at the contact with serpentine".

Santos-Yñigo (personal communication) reports that the coastal area between Tandog and Lianga Bay consists of interbedded metavolcanic rocks and argillaceous sediments which strike in a northernly direction. Some of the volcanic rocks possess well-defined pillow structures.

Southeast Cordillera.—West of Pujada Bay, opposite the base of Davao Peninsula, basic and intermediate volcanic rocks are reported altered in part to chloritic schist. From notes by

Goodman, Smith (1924, p. 239) reports that rocks consisting of hornblende diorite and chloritic schists crop out in the area of the Diuata Mountains. A finely laminated mica schist with considerable calcite is also abundant.

In the Davao Gold Mine area near Pantukan, 60 kilometers northeast of Davao, Ira Jaroleman (personal communication) reports that the country rocks consist of andesitic to latitic lava flows with interbedded compact, well indurated, pyroclastics some of which may be as acidic as rhyolite in composition. This sequence is moderately folded along north-south axes and is intruded discordantly by medium to coarse grained diorite. Outside of the mine area itself, considerably deformed, dark gray limestone (Eocene?) appears to overlie the volcanics. From the compact and indurated nature of the pyroclastic volcanics, the volcanic series may be pre-Tertiary, but the diorite intrusives and gold mineralization, which is similar to the Surigao district, are considered to be possibly much younger.

The central part of the Davao Peninsula is composed of serpentine and peridotite. Along the western side of the peninsula, near the village of Piso, Mr. L. J. Sundeen (personal communication) reports chromite and magnesite deposits in these rocks.

CENTRAL MINDANAO

Bukidnon.—On the Sayre highway south of Del Monte, various phyllitic schists, including piedmontite schist, were collected by Grant W. Corby before the war.

Misamis Oriental.—Southwest of Cagayan, a large area of chlorite schist, slate, and phyllite ranging from magnesia-rich to argillaceous and siliceous types, are cut by serpentine masses that contain scattered lenses of chrome ore. The metamorphic rocks occasionally contain small gold-quartz veins.

The oldest known Tertiary formation overlying these rocks is Eocene in age. These sediments are found in Bukidnon Province. Elsewhere the oldest Tertiary formations are Miocene.

Cotabato.—Basement rocks crop out in small areas along the road between Cotabato and Davao to the east, but there is no information on the rock types. Tertiary sediments and recent volcanics are the principal rocks exposed over this vast area.

ZAMBOANGA PENINSULA

A belt of highly deformed chloritic schist, gneiss, slate, and quartzite is reported along the mountainous axis of the Zamboanga Peninsula. Serpentine crops out locally.

A broad area of quartzite is exposed on Mt. Kaladis, west of Malangas, Sibuguey Peninsula. Glenn Brown (personal communication) believes that the quartzite capping of Mt. Kaladis may have been thrust up from the south overriding coal-bearing Miocene sediments of the Malangas coal district. Similar quartzite is found in the Pablo Penao Range north of Zamboanga.

SULU ARCHIPELAGO

Many islands of the Sulu Archipelago stretching between the Zamboanga Peninsula of western Mindanao and northeastern Borneo are composed of volcanics, though some are fringed and several are completely covered by clastic sediments and coral reef formations. The southern Tawi-Tawi Island group, however, is extensively underlain by basement formations, demonstrating that the submerged ridge along which this archipelago is distributed is composed essentially of crystalline rocks, and is not a constructional ridge of recent volcanic origin.

The oldest rocks exposed in the Sulu Archipelago, according to mapping by F. Merchant (Corby, 1940), is serpentine that underlies the northern half of Tawi-Tawi Island and the nearby Tumbagaan, Basbas, and Tagalongan Islands. On the Maraning River, Tawi-Tawi, the serpentine is said to be intruded by gneissoid rocks and by later pegmatites and quartz veins. At Port Languyen, the serpentine reportedly contains small amounts of chromite. The core of Sibutu Island, of the Sibutu group, is reported to consist of diorite.

Metamorphic rocks are found on Baliungan, Tandubato, Dandangan, Tandungan, and Calupag Islands southeast of Tawi-Tawi Island, but have not been described. Maniacola Island, which lies northeast of Tawi-Tawi, is reported to be composed of metamorphic rocks intruded by diorite. The islands of Sugbai and Bubuan are composed of metamorphosed agglomerate. On Tawi-Tawi the metamorphic rocks are reported to overlie the serpentine unconformably, dipping gently to the north, and to attain a thickness up to 1,000 feet. The metamorphics there in turn are overlain by volcanics and sediments.

If it is true that this metamorphic sequence overlies the serpentine, then it follows that some older country rock must exist into which the serpentine was intruded. The intrusion of agglomerate by diorite on Maniacola suggests the possibility that a younger igneous cycle may exist.

The overlying sediments and volcanics have not been dated paleontologically, and there is no basis for ascribing a minimum age to the metamorphic rocks or to the diorite intrusives.

PROBLEMS IN BASEMENT GEOLOGY AND CONCLUSIONS

(1) Nearly fifty years ago George F. Becker stated, "It would seem that from early Paleozoic times onward an archipelago has usually marked the position of these islands. Prior to the Eocene nothing definite is known of them; further investigation will very likely disclose Paleozoic and Mesozoic strata there."

Although Paleozoic and Mesozoic strata are present in the East Indian archipelago to the south and in Formosa and the Japanese archipelago to the north, investigation in the Philippines to date have revealed only that fossiliferous Jurassic and Cretaceous sediments are present. Below these sediments are metamorphic and igneous terrains whose precise geologic age is not known, and because of large distances, geologic correlation with rocks of other areas is yet quite premature. On the other hand, there are large areas of slightly metamorphosed sediments which, when careful search is made, may well yield older fossils. These areas crop out in east-central Luzon, and on the islands of Masbate, Mindoro, Panay, Cebu, Busuanga, and Mindanao.

Axiomatic principles of stratigraphy tell us that all formations of a stratigraphic nature, whether sedimentary or of volcanic origin, whether metamorphosed or not, must have been derived from some pre-existing terrain and deposited upon some pre-existing, and therefore older, floor. Each stratigraphic unit or formation therefore, irrespective whether or not it is cut by deep-seated intrusives, must be succeeded downward in the geologic column by another formation, or series of formations, until some fundamental basement is approached. Until such time that the great variety of metamorphosed formations of the Philippines are carefully unraveled as to sequence, the fundamental basement and the successive episodes of early geologic history must remain in the dim twilight of knowledge of the ancestral Philippines. The great length of geologic time before the Jurassic or Cretaceous periods leads one to suspect that probably many important periods of sedimentation have occurred and these sediments have been involved probably in several great periods of mountain building. Consciousness of this probability is a first prerequisite to a proper geologic frame of mind in approaching the study of these rocks.

(2) The largest iron and all chromite deposits of the Philippines are related to "pre-Tertiary" ultrabasic intrusives; many small copper and cupriferous pyrite deposits are associated with intermediate plutonics; several hypogene manganese deposits occur in metamorphosed argillites, quartzites, and cherts; certain gold deposits are associated with granitoid intrusives, and apically truncated granitic stocks offer promising fields for future prospecting; weathering and erosion of granitic masses result in commercial quartz sand deposits; and granitoid rocks, silicified serpentines or serpentine breccias, and marbles, may provide the basis for polished-stone industries.

The entire metal mining industry of the Philippines, moreover, is largely concerned with ore deposits occurring either within basement formations, or within Tertiary volcanic formations that have been similarly neglected. Whatever the age or ages of metalization, until these areas are properly investigated, many important facts of economic significance will not be available.

(3) From both scientific and economic standpoints, therefore, careful and thorough investigation of basement areas is urgently needed. Comprehensive study of these formations will not be easy. Besides inherent and original complexity, most basement formations have passed through one or more orogenic disturbances, and the resulting structural and metamorphic effects must be evaluated and discounted in order to arrive at proper interpretations. Moreover, because of the archipelagic nature of the islands, and further, because of the extensive Tertiary sedimentary cover, study of these terrains is limited to geologic windows which reduce opportunity for uninterrupted study and continuous geologic correlation of formations. Because of the paucity of fossils, geologic correlation may be limited largely to physical criteria. Nevertheless, by application of time-proven petrologic and petrographic, stratigraphic, and structural methods, assisted by more recently developed techniques including petro-fabric investigations, metamorphic facies studies, igneous cycle and metallogenic studies, and geologic age determinations by radioactivity, much will be learned of these proto-Philippine formations.

(4) From the preceding review, several generalizations appear to emerge:

(*a*) The outstanding geochemical feature of the basement formations is its average basic composition. Peridotites or sepentines, gabbros, and diorites are the prevailing igneous types. Many basic schists probably are derived from basic volcanics or ultrabasic plutonic intrusives. Although persilicic plutonic rocks are present in the western and northern islands, true granites are so rare as to be considered petrographic oddities. The average basic composition of basement terrains may explain geochemically why chromite, manganese, copper, and iron are the principal base metals produced from the Islands almost to the exclusion of other alloy or base metals, and pegmatitic minerals or metals.

(*b*) In part because of the basic nature of the primary source rocks, the predominant sedimentary rocks of these formations are graywackes or their compositional equivalents. Phyllites and schists of the clay-slate series appear to be the next most common, although bedded cherts which are not to be confused with jaspers of hydrothermal origin, are widespread and occurs as horizons within other sedimentary types, or within volcanic sequences. Quartzites are found mainly in the southerwestern islands. The fact that calcareous sediments are so limited in quantity in contrast to their extensive development in the superjacent Tertiary section, probably like the quartzites, has paleogeographic and paleoecologic significance.

(*c*) Metamorphosed volcanic formations in the basement are becoming recognized with increasing frequency. The general composition and constitution of the known basement formations suggest they are not typically continental or sialic in constitution. Considering the archipelagic nature of the islands, which condition has existed at least during much of Tertiary time, and probably before, this raises the question whether the islands originated by constructional volcanic process from the Pacific floor, or whether the foundation rocks are of tectonic origin and have been elevated from the simic floor of the Pacific Basin. The hypothesis that the Philippine area was once a part of the Asiatic mainland that has since founded, is not considered. The foundering or submergence of a peninsular area, or a land bridge such as Sundaland may have been, on the other hand, does not introduce problems of mechanics as that of continental fragmentation.

(5) Ultrabasic plutonites are widespread and can be expected in any exposed area of basement formations. Careful plotting of occurrences disproves earlier statements that they crop out in two longitudinal belts, one along the eastern and another along the western side of the islands. Plotting shows, instead, that their distribution is related to circumstantial exposure of basement terrain. An accurately prepared map showing distribution of peridotites and serpentines, incidentally, would be of considerable assistance to the prospector who is interested in the metals they may contain, particularly chromite, lateritic iron, and possibly lateritic nickel.

The discovery by Kemmer of possibly two periods of peridotite intrusion in the Surigao iron reservation, Mindanao, poses the question whether the widespread peridotite and serpentine masses of the Philippines are all of the same age. It is possible that they, as well as other plutonic intrusives, may be of quite different ages in different areas.

(6) Quartz-bearing plutonic intrusives appear to be limited mainly to the area northwest of a line passing from south of Palawan, north of Panay, south of Marinduque and southeast of the Paracale district, Luzon. For want of a better term, this line may be tentatively referred to as the "granite line".

This apparent distribution of quartzose plutonics may have tectonic significance. Structural lineation in the Philippines, although only slightly known, appears to be built up on two systems of arcs. The western islands together with Mindoro and northern Luzon describe an arc of southeastern convexity. The Sulu Archipelago, Zamboanga Peninsula, and west-central Visayan Islands appear to be sympathetically related to this system. The southeastern islands of powerful lineation, describe an arch of northeastern convexity. The first arc may be related to the outer edge of pre-Tertiary and early Tertiary Sundaland. The second arc, judging from metamorphism of Tertiary sediments at a number of localities and from the presence of Tertiary plutonic intrusives in the Paracale and Baguio mining districts, suggests that its present accentuated form, at least, is of late Tertiary age.

(7) Thus far, gold deposits related to pre-Tertiary plutonic intrusion are small and widely scattered. The great gold districts of the Philippines are located along the southeastern arc of late Tertiary age. Powerful gold mineralization along this zone denotes a sharp change in the character of mineralization since "pre-Tertiary" time. Detailed geologic study of this zone conceivably might disclose similar centers elsewhere of intense gold mineralization.

(8) The discovery by Pratt of metamorphosed Tertiary sediments on the Caramoan Peninsula and the observations by Meek in the Paracale district, and by Wisser and Schafer in the Baguio district, that diorite and granodiorite apparently intrude metamorphosed Tertiary sediments provide a sharp warning that metamorphism and plutonic intrusion are not peculiar to "pre-Tertiary" basement formations.

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NOTEWORTHY ADDITIONS TO THE PHILIPPINE FISH FAUNA WITH DESCRIPTIONS OF A NEW GENUS AND SPECIES

By ALBERT W. HERRE[1]
School of Fisheries, University of Washington
Seattle, Washington
and
EARL S. HERALD[1]
Steinhart Aquarium, California Academy of Sciences
San Francisco, California

TWELVE TEXT FIGURES

The Philippine Fishery Program of the Fish and Wildlife Service,[2] United States Department of the Interior, is assisting the Philippine Government in the rehabilitation, development, and modernization of the fisheries. Incident to the experimental and exploratory fishing activities, and in connection with the fishery biological investigations many specimens of fishes were collected. Unfortunately a complete survey of the ichthyological fauna is not authorized by law as a part of the program. Nevertheless, a study of the collections made during the year preceding May 30, 1948, disclosed some surprising records and furnished much valuable information concerning certain commercial fishes and about the geographical distribution of others.

The collections made with the aid of electric light at night from the M. V. *Spencer F. Baird* and the M. V. *Theodore N. Gill,* and the examination of the stomach contents of various commercial pelagic fishes have been of particular interest. New and important distributional data about larval and juvenile forms, as well as of adult fishes, were obtained.

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[1] Dr. Herre was formerly Ichthyologist and Dr. Herald was formerly Aquatic Biologist, Office of Foreign Activities, Fish and Wildlife Service, and served as members of the staff of the Philippine Fishery Program with headquarters in Manila.

[2] The Philippine Fishery Program of the Fish and Wildlife Service is part of the Philippine Rehabilitation Program of the United States Government authorized by law (50 App. U.S.C., Sec. 1789) and is conducted pursuant to an inter-governmental agreement signed in Manila, March 14, 1947.

Collections from beam trawlers in Manila Bay gave a new genus and species, as well as a number of other fishes previously unknown in Philippine waters, but known to science from other regions. Collections from the fish corrals of the south coast of Batangas Province, Luzon, showed an abundance of noteworthy fishes hitherto unobserved. Knowledge of the presence and capture in commercial quantities of one of these supposedly very rare fishes was one of the most interesting results obtained by a study of native fishing methods.

Most valuable specific and distributional data remain to be gleaned from the catches obtained by trawlers in Philippine waters, and by the native baklad or fish corrals set in water from 40 to 200 feet deep. Careful records and a detailed analysis of these fisheries are needed. Such work should be conducted seasonally over a long term of years in such places as Batangas Province, Luzon; Antique Province, Panay; Zamboanga Province, Mindanao, Basilan Island, and in fact wherever the fishing methods mentioned above are in operation.

The Checklist of Philippine Fishes by the senior author (in press) gives 2,145 species thus far known from Philippine waters. This very large number is by no means the total fish fauna occurring within the limits of the Philippine Islands. It will be a very long time before the entire Philippine fish fauna is completely known, and surprising additions may be looked for during the coming years. Great stretches of coastline have never had any scientific collections of fishes made in their waters, while the fresh-water streams of most of the islands are imperfectly or not at all known. A few months devoted to intelligent and intensive collecting in certain localities could easily add fifty species to the Philippine fish fauna.

Unless otherwise specified all lengths given are in standard length.

Family OPHIDIIDÆ

Genus UMALIUS Herre and Herald

Lepophidium Umali, Philip. Jour. Sci. 56 (1935) 323; not of Gill.

Only one species known as yet, and thus far not taken outside the Philippines.

Body elongate, moderately curved, the body ending posteriorly in a point, scales cycloid, imbricated; the conspicuous lateral line concurrent with the back, ending a slight distance before the

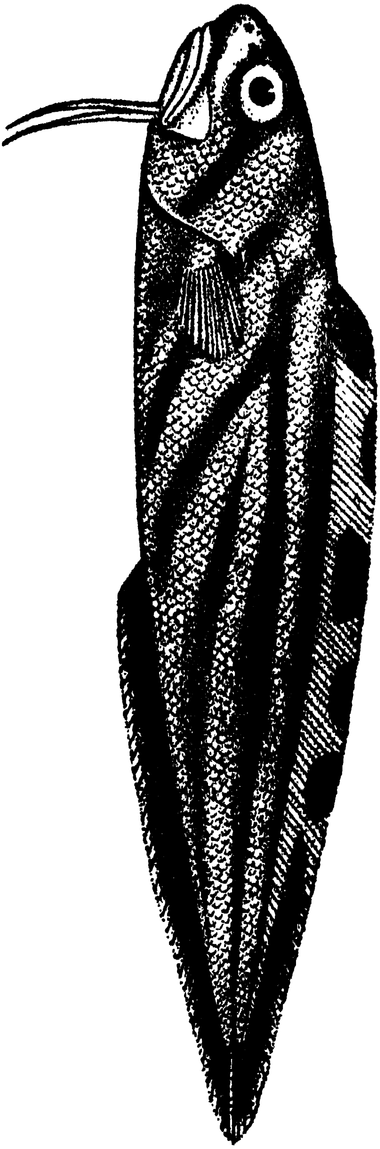

FIG. 1.

caudal, but probably complete in life; opercle with a sharp spine, not concealed; no spine on the prominent snout; mouth oblique, inferior; teeth in three rows anteriorly and two rows laterally, all teeth sharply pointed, curved, movable, and immersed in a papillose membrane; a strong band of small stout teeth on vomer and on palatines.

Type *Umalius philippinus* Herre and Herald, new species. This genus is close to *Lepophidium* and *Otophidium* Gill, but differs especially in the dentition and opercular spine. Named for Mr. A. F. Umali, able and zealous student of Philippine fishes and fisheries.

UMALIUS PHILIPPINUS Herre and Herald Fig. 1.

Lepophidium marmoratum Umali, Philip. Jour. Sci. 56 (1935) 323, *plate 1, fig. 3,* not of Goode and Bean.

Divisoria Market, Manila, Luzon.

Dorsal about 89; anal about 64; pectoral 24; scales along lateral line about 82; gill rakers on first gill arch short, somewhat curved, stout; gill raker formula 0 + 4; rounded tubercles between rakers are 4 + 6.

The compressed elongate body is deepest at the origin of the first dorsal, the dorsal and ventral outlines tapering uniformly to the caudal, the depth 5.4 times in the length. The head is large, 4.2 times in the head, and longer than the snout. The snout equals the interorbital and is 4.28 times in the head. The inferior mouth is moderately large, the maxillary extending a little beyond the hind margin of the eye, 2.14 in the head, with its posterior extremity broad; the opercle ends in a rather stout sharp spine, which extends almost to the margin of the opercular flap.

The cycloid imbricate scales are embedded with only that part in the scale pocket visible; they are largely deciduous; the whole body is covered with scales except the snout and under side of the head; the dorsal and anal are low and confluent with the caudal; the pectorals are short and equal to one and seven-eighths of the head; the ventrals are slightly longer than the pectorals; the anus is almost in the middle of the length.

The color in alcohol is yellow or yellowish, with four dusky brown bands as follows: one from the origin of the dorsal passing subdorsal along the back and extending nearly to the caudal; two broad bands of the same color cross the nape and

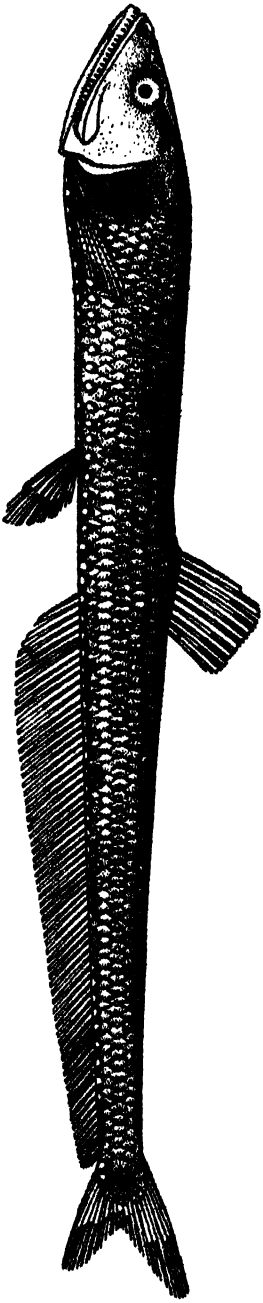

FIG. 2.

descend obliquely to the belly, the posterior one sending a stripe of brown along the lateral line; a broad dark brown blotch covers the interorbital space and sends an oblique band along the hind margin of the eye to the posterior angle of the opercle. The dorsal is cream color, with 5 large semicircular black spots on the upper half of its anterior two-thirds and the rest of the fin and the anal with a broad blackish longitudinal band and narrow pale margin. The pectorals are nearly colorless, probably yellow in life, specled with minute dusky dots; the ventrals are very pale yellowish.

Here described from the type and sole specimen, 126 mm. long. It was taken by a beam trawler from Manila Bay in 13 to 25 fathoms, June, 1947. This is the second Philippine specimen collected and the only one known at present. Umali's specimen was lost when the Japanese wantonly destroyed the Bureau of Science.

Family MAUROLICIDÆ

Genus DIPLOPHOS Günther

DIPLOPHOS TAENIA Gunther. Fig. 2.

Five specimens, 34 to 41 mm. in length, were taken in the Sulu Sea by surface plankton tow net at night, at Lat. 6° 48.5′ North and Long. 118° 51.5′ East. This species was previously known from the tropical and southern Atlantic and Indian oceans.

Measurements and counts of the 5 specimens are as follows:

Total length	34	36	38	40	41
Dorsal rays	10	10	10	10	11
Anal rays	59	60	61	59	60
Pectoral rays	9	9	9	9	9
Lower row photophores	102	101	97	103	100
Upper row photophores	67	66	66	68	69
Lateral line	89	89	91	92	92

Barnard, in Annals South Africa Museum, vol. 23, p. 149, mentions a suborbital and three opercular photophores, as well as smaller ones on the upper and lower jaws. These are not visible in the specimens at hand.

According to Parr's study of *Diplophus* (Bull. Bingham Oceanogr. Coll., vol. 2, art. 4, p. 11, 1926) *D. tænia* Günther is most easily segregated from *D. pacificus* Günther on the basis of the anal ray count, the former species having 58 to 61 rays and the latter 53 rays.

Family NETTASTOMIDÆ

Genus CHLOPSIS Rafinesque

CHLOPSIS FIERASFER Jordan and Snyder

A specimen 445 mm. long was taken by a beam trawl operating in Manila Bay near Corregidor Island, at a depth of 19 to 29 fathoms, June 10, 1947. The first Philippine record and a surprising find. This species has been known hitherto from deep water near Japan.

Family MORINGUIDÆ

Genus MORINGUA Gray

MORINGUA BICOLAR Kaup

A specimen was taken while fishing with electric light at Masinloc anchorage east of Zamboanga City, Zamboanga Province, Mindanao. The first Philippine record and a notable extension of its range. This fish has been known previously from Flores and Timor in the East Indies, New Britain in the Bismarck Archipelago, and Kandavu, one of the Fiji Islands.

MORINGUA CAGAYANA Seale

A specimen 580 mm. long of this unique eel was taken at Caldera Bay, Zamboanga Province. The type, destroyed by the Japanese when they eliminated the Bureau of Science, was for many years the only specimen known. In 1940 I obtained 2 at Dumaguete, and this makes the third specimen now available.

Family PARALEPIDÆ

Genus LESTIDIUM Gilbert

LESTIDIUM PHILIPPINA (Fowler)

A number of examples up to 163 mm. in length, were obtained in Batangas and other markets of Batangas Province, Luzon. The only other specimens known are the type and five paratypes taken by the *Albatross* on the opposite side of Verde Island Passage, at Varadero Bay, Mindoro. The species does not appear to be uncommon in the nightlight catches along the Batangas coast.

Family BREGMACEROTIDÆ

Genus BREGMACEROS Thompson

BREGMACEROS MCCLELLANDI Thompson

Three specimens 81 to 88 mm. in length were taken by trawl from Manila Bay, June to September, 1947, in 19 to 29 fathoms of water. Not uncommon in the nightlight catches taken in Balayan and Batangas Bay. This little fish was first recorded from the Philippines by Günther in 1862. No other specimens have been noted, although Günther's record has been copied by other authors, and Weber and de Beaufort listed the species as "near Philippines". These are therefore the second positive Philippine records.

Family SOLEIDÆ

Genus ASERAGGODES Kaup

ASERAGGODES FILIGER M. Weber

A typical specimen 100 mm. long was taken by beam trawl from Manila Bay within 8 miles of Corregidor Island, in 13 to 25 fathoms of water, June 27, 1947. This is the first Philippine record. Previously known only from the Java Sea, off Pekalongan, Java, and from the island of Rotti, Dutch East Indies.

Family MONOCENTRIDÆ

Genus MONOCENTRIS Bloch and Schneider

MONOCENTRIS JAPONICUS (Houttuyn)

Five specimens of this remarkable fish were taken by the *Theodore N. Gill,* using an otter trawl just outside Manila Bay in 65 fathoms. They were from 100 to 162 mm. in length. Since then more specimens have been taken by other trawlers and the fish seems to be not rare in Philippine waters. Originally described from Japanese waters, it is also known from the coast of China, the Dutch East Indies, the Andaman Islands, Mauritius, and the east coast of Africa.

Family SYNGNATHIDÆ

Genus HALICAMPUS Kaup

HALICAMPUS GRAYI Kaup

This species was obtained from the stomachs of the yaito tuna, *Euthynnus yaito,* caught by trolling on two occasions in January, 1948, near Pilas Island, west of Basilan Island, in the Sulu Sea. One pipefish was taken on January 7 and 30 more pipefish were taken from the stomachs of four yaito tuna on January 14. The longest of these pipefish was 70 mm. long.

These specimens all fall within the limits of the species as defined by Duncker and by Weber and DeBeaufort, Fishes of the Indo-Australian Archipelago, 4 (1922) 103, *fig. 43.* They present one notable difference. The figure referred to above shows a species with a short snout, 2.7 times in the head. All our specimens are with a proportionately long snout, which is

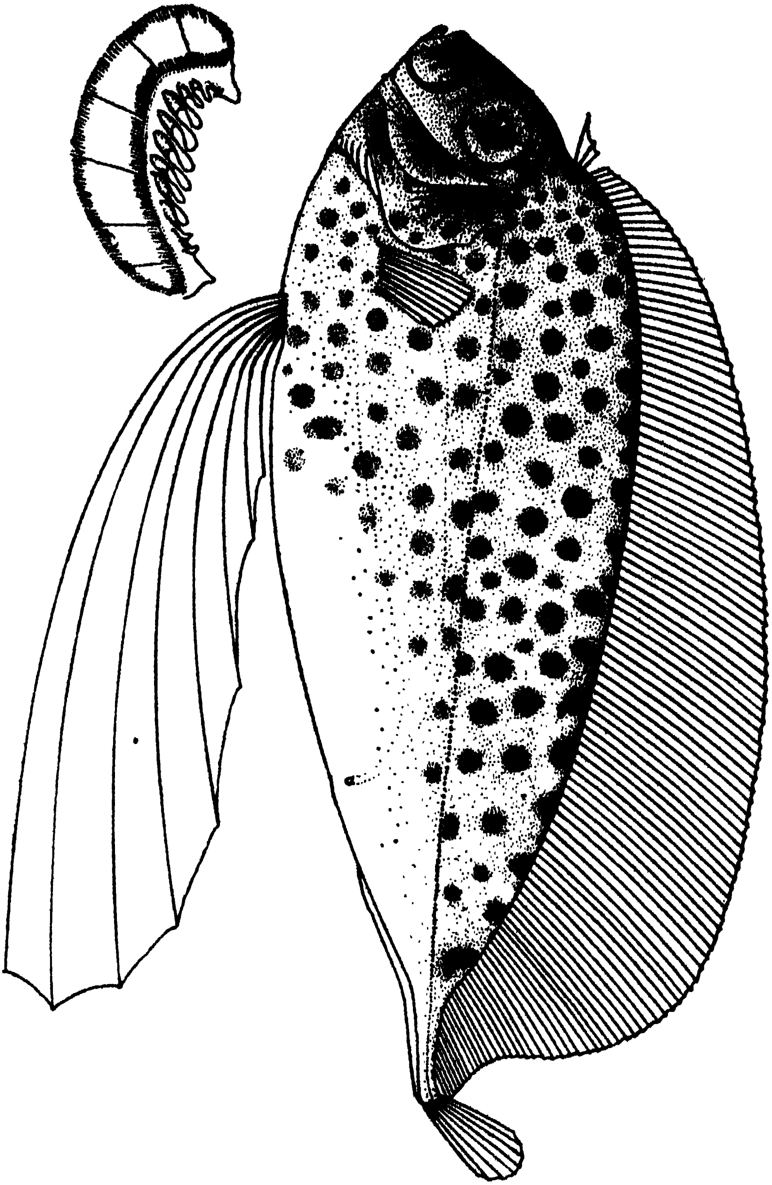

FIG. 3.

contained but twice in the head. It would require comparison with museum material not available at the time of this writing to determine the significance of this difference.

This is the second Philippine record. It was described by Alvin Seale under the name of *Trachyrhamphus caba* Seale and was from Balayan Bay, Batangas Province, Luzon. (The Philippine Journal of Science, vol. 4, sect. A, p. 503, 1909).

This pipefish is known elsewhere from the Andaman Islands, Japan, New Guinea, Thursday Island, Prince of Wales Island, and Northwest Australia.

Genus YOZIA Jordan and Snyder

YOZIA BICOARCTATA (Bleeker)

A male specimen 213 mm. long, with embryos in its brood pouch, was taken from Manila Bay by otter trawl in 18 fathoms of water, November 20, 1947. This is the first and only Philippine record.

Length 213 mm.; head 20.5 mm.; snout 10.4 mm.; dorsal fin base 14.8 mm.; dorsal rays 28; pectoral 18; anal 4; caudal 9. The dorsal lies above 3 trunk rings and 2 tail rings. The brood pouch is beneath 19 tail rings.

Previously known from China, Japan, Singapore, Sumatra, Amboina, the east coast of Africa, and Mauritius.

Family TRACHYPTERIDÆ

Genus TRACHYPTERUS Gouan

TRACHYPTERUS MISAKIENSIS Tanaka Fig. 3.

One specimen 90 mm. in length was taken under the night-light eight miles south of Pilas Island, Sulu Archipelago at Lat. 6° 26′ North; Long. 121° 35′ East. This is the first Philippine record and is believed to be the fifth known specimen, the other four being the original types. Pertinent data on this specimen are as follows: total length 99 mm.; dorsal 3, 112; caudal 8; pectoral 10; ventral 8; lateral line 165; gill rakers $3 + 1 + 7 = 11$; the asymmetrical anal pore located on the left side is of considerable interest. Mr. Donald E. Kauffman has kindly made available the following color notes taken at the time the specimen was brought aboard the M. V. *Theodore N. Gill:* "Body metallic silver with light black round spots extending from head to caudal peduncle above lateral line, the posterior ones becoming slightly larger, irregular and indistinct. Dorsal rays brilliant salmon color for four-fifths the length of the fin, the remaining one-fifth faintly pink. Ventrals pinkish with very delicate filmy appearance. Pectorals hyaline. Caudal bright salmon."

Since the trachypterids are noteworthy for their change in body proportions from juvenile to adult, it was necessary to graph all characters of the types in order to compare them with the Philippine specimen. From these rough plots it appears very probable that one of the two smaller paratypes is a different species from the remaining types. To which of these possible species the Philippine specimen belongs cannot be determined without re-examination of the original material.

Allowing for growth changes the Philippine specimen differs most markedly from the type illustration of *T. misakiensis* in (1) eye-in-head value; (2) longest ventral-into-standard length value; (3) free ray count of the dorsal; (4) asymmetrical versus symmetrical anal pore; (5) and in the arrangement of the lateral pore system.

Family THUNNIDÆ

Genus AUXIS Cuvier

AUXIS TAPEINOSOMA Bleeker

Previously it was thought that but one species of frigate mackerel, *Auxis thazard*, occurred in Philippine waters. Our studies show that two species are present, and we believe them identical with Kishinouye's *Auxis hira* and *Auxis maru*. *Auxis hira* is probably a synonym of *Auxis thazard* Lacépède and *A. maru* seems to be a synonym of *Auxis tapeinosoma* Bleeker. The status of these names, as well as that of *Auxis rochei* can be settled only by a re-examination of the types of these species, as well as by detailed study of the frigate mackerel populations in the areas in which they occur. At present we apply the name *Auxis thazard* in the Philippines to the species with fewer gill rakers and *Auxis tapeinosoma* to the species with a larger number of gill rakers. As first indicated by Kyshinouye the width of the corselet along the lateral line is often enough to differentiate adults of the two species in the field. Table 1 presents the gill raker counts for the two Philippine species of *Auxis* as well as a sample of the Atlantic American population which has been known under the specific name of *thazard*. From this table it is apparent that insofar as gill rakers are concerned the Atlantic *thazard* are slightly different from the Philippine *thazard* and the difference is greatest on the lower arch. The Atlantic specimens of *A. thazard* which were examined were all contained in the collection of the U. S. National Museum.

TABLE 1.—*Comparison of gill raker counts of Philippine and Atlantic American frigate mackerels*

Gill rakers		Auxis thazard		Auxis tapeinosoma
		Philippine	Atlantic American	Philippine
Upper arch	7	3		2
	8	0	3	2
	9	27	12	3
	10	21	7	75
	11			74
	12			5
Center	1	51	22	161
Lower arch	28	1		
	29	14		
	30	21	5	
	31	13	4	1
	32	2	6	17
	33		6	38
	34		1	53
	35			30
	36			19
	37			3
Total rakers	38	3		
	39	8	1	
	40	18	2	
	41	12	7	2
	42	9	3	2
	43	1	5	13
	44		4	28
	45			40
	46			37
	47			20
	48			13
	49			3
	50			3
Number of specimens		51	22	161
Fork length size range		51-441 mm	255-345 mm	53-217 mm
No localities represented		5	4	4

Family GEMPYLIDÆ

Genus RUVETTUS Cocco

RUVETTUS PRETIOSUS Cocco **Oil Fish**

A specimen weighing 10 pounds was observed in the market at Zamboanga, Mindanao, March 9, 1948. The Samal name for the oil fish is ulago. This was said to be the first specimen brought to the Zamboanga market for nine years. However, people were well acquainted with the remarkable purgative effect of the flesh of this fish. This is the second Philippine occurrence to come to our attention, the first being observed by Herre who found three specimens in the Manila market. They had been caught along the north coast of Camarines Norte Province, Luzon. The species occurs at depths of about 300 meters to perhaps a kilometer and therefore is not commonly taken by Philippine fishing methods. Circumtropical in distribution and originally described from the Mediterranean.

Genus JORDANIDIA Snyder

JORDANIDIA PROMETHEOIDES (Bleeker) Fig. 4.

Ten examples 168 to 190 mm. in length were obtained during April and May, 1948, from the markets of Batangas, Lemery, and Taal, Batangas Province, Luzon. Three additional specimens, 75 to 145 mm. in length, were taken from the stomach of a specimen of *Katsuwonus pelamis* caught in Moro Gulf, south of Zamboanga Province, Mindanao, at approximately Lat. 7° North and Long. 123° 49′ East.

This fish is not uncommon in the markets along the Batangas coast during March, April, and May. The people believe it to be the young taniging bato, *Acanthocybium solandri.* It is usually attracted by light at night and taken in the basnig nets of Balayan and Batangas bays, Batangas Province, Luzon. Known from the East Indies to the Bay of Bengal.

Genus GEMPYLUS Cuvier

GEMPYLUS SERPENS Cuvier and Valenciennes Snake Mackerel

A specimen 540 mm. long was caught while fishing with a night light from the M. V. *S. F. Baird* in the Sulu Sea at Lat. 9° 44′ North, and Long. 120° 33′ East. A second specimen 160 mm. long was obtained from the stomach of a skipjack, *Katsuwonus pelamis*, caught in the Celebes Sea east of the Sulu Archipelago at Lat. 5° 20′ North, and Long. 123° 7′ East, on March 9, 1948. New to the Philippines but widely distributed in the open Atlantic, Pacific, and Indian Oceans.

Family ISTIOPHORIDÆ

Genus ISTIOPHORUS Lacépède

ISTIOPHORUS ORIENTALIS Schlegel Sailfish Fig. 5.

A specimen 159 mm. long was taken in the Sulu Sea while fishing with electric light, December 5, 1947, at Lat. 6° 57′ North and Long. 121° 2′ East. A second juvenile specimen 445 mm. long was caught while fishing at night from the M. V. *S. F. Baird* in the Celebes Sea west of Cotabato Province, Mindanao, at Lat. 6° North and Long. 123° East, on March 9, 1948.

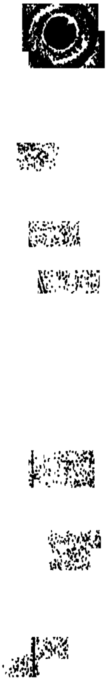

FIG. 4.

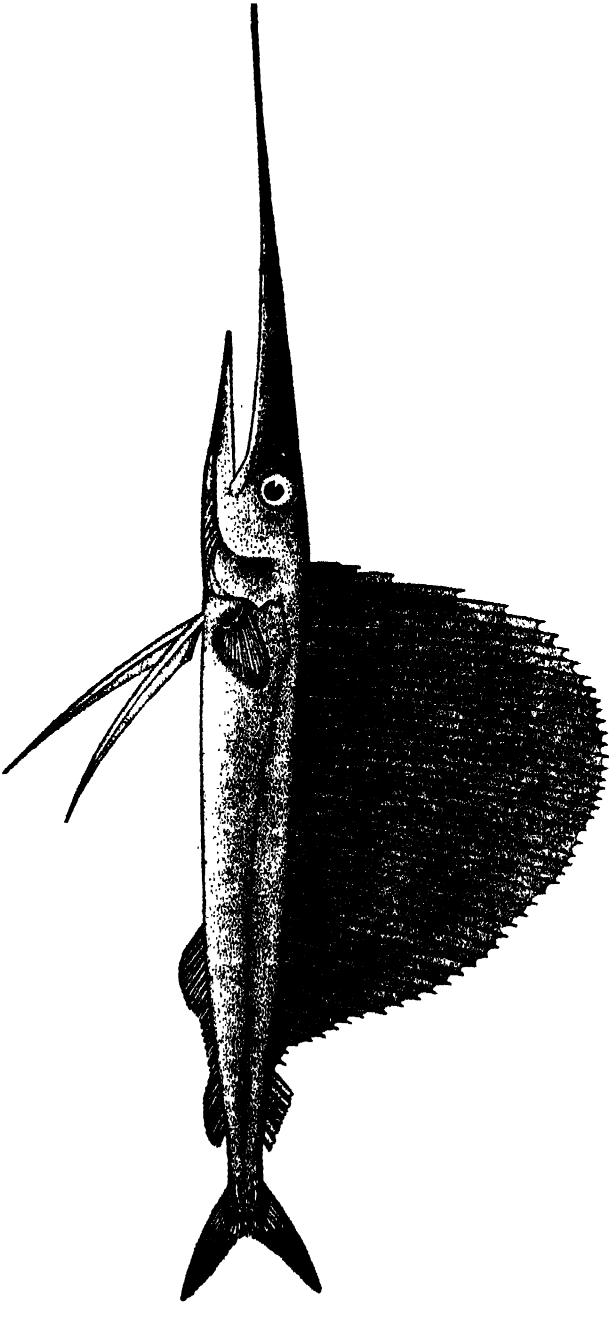

FIG. 5.

Istiophorus orientalis the sailfish, is common in the Philippines and many are taken by sport and commercial fishermen, but the above are the first juvenile examples known from the islands. First described from Japan, it is known eastward to Hawaii and southward through the East Indies.

Family XIPHIIDÆ

Genus XIPHIAS Linnaeus

XIPHIAS GLADIUS Linnaeus Swordfish Fig. 6.

Two juvenile specimens, 41 and 44 mm. in length, were taken in the Sulu Sea while fishing with a light from the M. V. *S. F. Baird* at Lat. 7° 21′ North and Long. 119° 27′ East. The swordfish is known from many records in the Philippines and many are caught every year by Filipino and American fishermen, both professionals and amateurs, but these are the first larval specimens known from Philippine waters. Found in all warm seas.

Family NOMEIDÆ

Genus NOMEUS Cuvier

NOMEUS GRONOVII (Gmelin) Fig. 7.

The illustrated specimen is 30 mm. in length and was taken by nightlight fishing in the Sulu Sea, Lat. 8° 27.5′ North and Long. 119° 34′ East. One other specimen 25 mm. in length was taken by nightlight in the Celebes Sea, Lat. 4° North and Long. 124° East. When this latter specimen came within the beam of the nightlight, it was at first mistaken for a flying fish as the widely expanded black ventrals simulated the pectorals of the short-winged flying fishes which were common in the area. It should be noted that the color pattern as well as the curvature of the throat is entirely different from that illustrated in Goode and Bean's Oceanic Ichthyology (1895, p. 220, fig. 227). This is the first Philippine record although the species has previously been known from the Atlantic and Indian Oceans.

Genus CUBICEPS Lowe

CUBICEPS GRACILIS Lowe

Twenty-three specimens 75 to 138 mm. in length were bought in the Lemery and Taal markets, Batangas Province, Luzon, in April, 1948. This fish is not uncommon on the Batangas coast, where it is known as "Iso." It is taken at night with the basnig, a lift net to which fish are attracted by a powerful lantern.

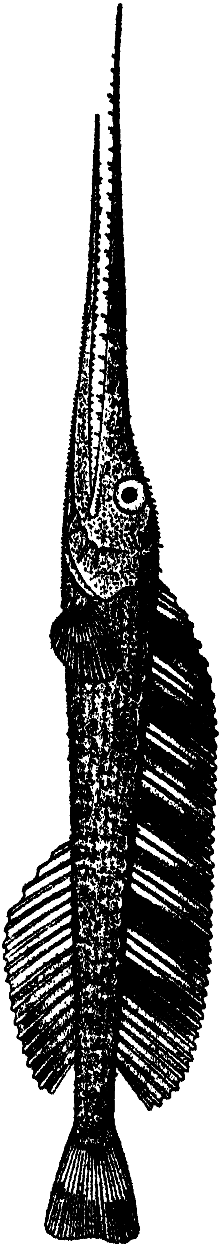

FIG. 6.

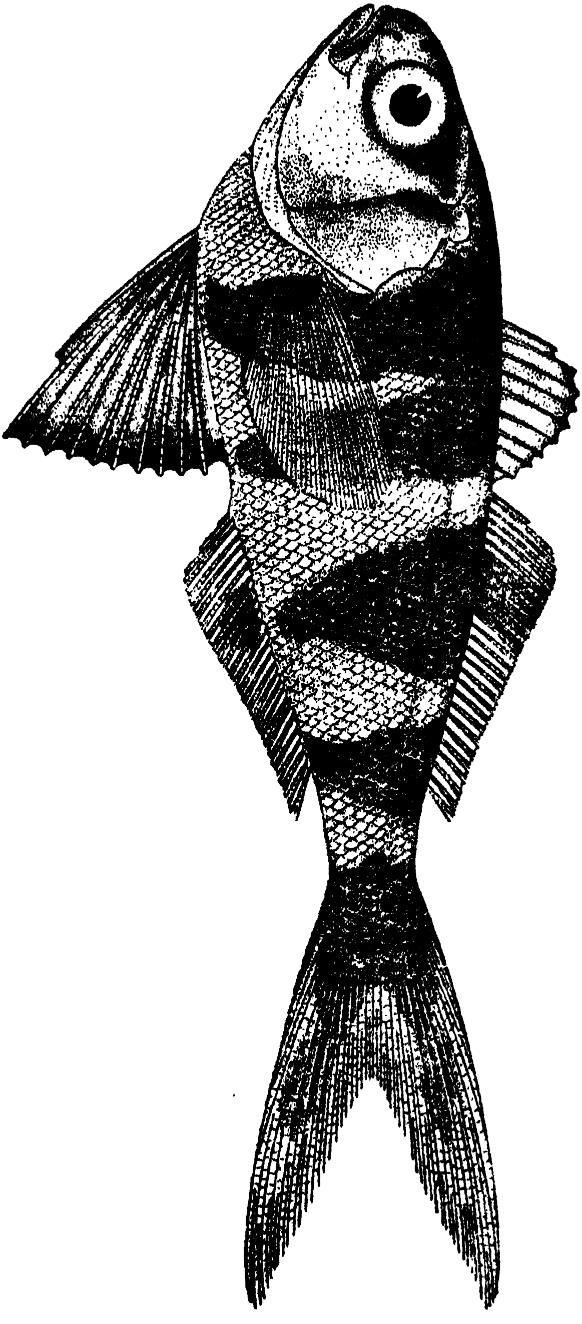

FIG. 7.

Dorsal XI—I—22; anal III—20 to 22; lateral line 66; gill rakers 4 + 13.

Another specimen 53 mm. long was taken in the Sulu Sea while fishing with a light south of Pilas Island, which lies west of Basilan Island.

This fish was originally described from the island of Madeira. It has also been taken in the Mediterranean off Sicily and in the Atlantic between Madeira and the Azores. It has been recorded doubtfully from the Cape of Good Hope. This is not only the first record from the Philippines but is a notable find in the discovery that this fish, hitherto known only from a few specimens taken on the other side of the world, is being caught commercially in Balayan Bay, where it is well known to the fishermen and market people. We may expect it to occur in equal abundance in the Sulu Sea and elsewhere in Philippine waters where basnig fishing is employed.

Family CORYPHÆNIDÆ

Genus CORYPHAENA Linnaeus

CORYPHAENA EQUISETIS Linnaeus **Little dolphin Fig. 8.**

Twenty-nine juvenile specimens from the Sulu Sea, Sulu Islands, and Celebes Sea, their lengths 19.5 to 161 mm.

Many young dolphins were attracted to the light when hydrographic stations were run at night from the M. V. *S. F. Baird*.

TABLE 2.—*Comparison of meristic characters of the Philippine Coryphæna*

	Dorsal rays													Anal rays							Number Specimens
	49	50	51	52	53	54	55	56	57	58	59	60	61	23	24	25	26	27	28	29	
equisetis	2	5	4	13	11	5	2	1							4	21	10	9			43
hippurus										2	7	3	1	2	2	2	3	2	1	2	14

Gill rakers

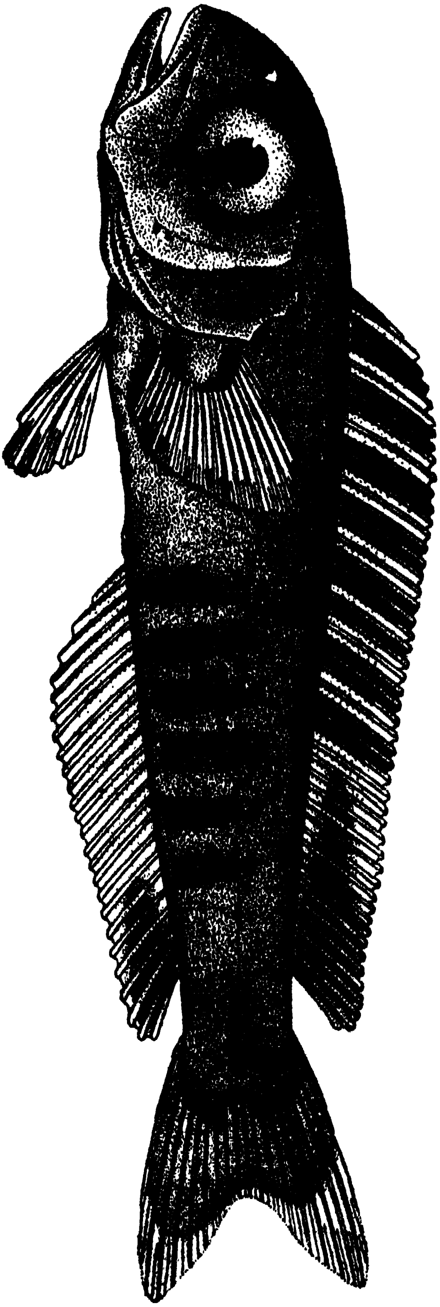

FIG. 8.

At first they were all referred to as *Coryphaena hippurus* as that was the only species recorded from the Philippines. However, examination showed that most of the juvenile specimens were of a different species from the adults commonly caught by trolling.

The best characters for separating the two species are the dorsal rays and the gill rakers, as shown in Table 2. Forty-three specimens of *C. equisetis* examined have 49 to 56 dorsal rays, while 14 spicemens of *C. hippurus* have 58 to 61 dorsal rays. *C. equisetis* always has at least one, and sometimes two gill rakers on the upper arch. *C. hippurus* usually has no gill rakers on the upper arch. Examination of 16 specimens of the latter species showed but one fish with a gill raker on the upper arch. The center gill raker between the upper and lower limbs of the gill is always present in both species.

Of 46 juveniles taken at sixteen different stations only two belonged to *Coryphæna hippurus*, all the rest being *C. equisetis*. The two young specimens of *C. hippurus* are 43 and 172 mm. in length. All other examples of *C. hippurus* to *C. equisetis* is approximately the same as the ratio found by Lutken in the Atlantic Ocean, as reported by Goode and Bean; Oceanic Ichthyology, p. 209, 1895. It may be possible that the young of *C. hippurus* are usually limited to deep water although evidence for such a hypothesis is not yet available.

There are seven localities from the Sulu Sea, three from the Celebes Sea, and one from Moro Gulf, which is a part of the Celebes Sea. The species are pelagic, and found in all warm seas.

TABLE 3.—*Locality records for Coryphæna equisetis Linnæus in Philippine and adjacent waters.*

Station number	Date	Number specimens	Mm Range standard length	Latitude	Longitude
B-48	12-4-47	2	19.5-34	8° 27.5′ N.	119° 34′ E.
B-51	12-4-47	2	68-107.5	6° 57.5′ N.	121° 02.5′E
B-54	12-5-47	2	67-122	6° 44′ N.	120° 06′ E.
B-57	12-6-47	1	66	8° 32′ N.	115° 20′ E.
B-64	12-10-47	1	76.5	6° 48.5′ N.	118° 51′ E.
B-117	3-1-48	1	32.7	5° 18′ N.	125° 30′ E.
B-139	3-9-48	5	45-61	5° N.	123° E.
B-141	3-9-48	3	124-161	6° N.	123° E.
G-47	4-13-48	8	36-57	10° 27.5′ N	121° 54.4′E
G-55	4-13-48	2	75-92	6° 26′ N.	121° 35′ E.
G-56	4-15-48	2	32-45	6° 46.7′ N	122° 21.5′E

Records adjacent to the Philippines

Station number	Date	Number specimen	Mm. Range standard lenght	Latitude	Longtitude
B-128	3-4-48	2	39–48.5	4° N.	12[illegible]
B-136	3-8-48	2	25–29	3° N.	123° E.
B-156	4-10-48	10	41–155	2° N.	121° E.
B-167	4-13-48	1	174	3° 01′ N.	118° 49.5′E

Family CARANGIDÆ

Genus NAUCRATES Rafinesque

NAUCRATES DUCTOR Linnaeus

One specimen 69 mm. in length was taken at Sibuguey Bay, Zamboanga Province, Mindanao and another 23.5 mm. in length was taken in the Celebes Sea, Lat. 4° North and Long. 124° East. One previous Philippine specimen recorded by Herre from Manila Bay.

Family LUTIANIDÆ

Genus PRISTIPOMOIDES Bleeker

PRISTIPOMOIDES TYPUS (Bleeker)

Many specimens up to two feet in length are taken by the fishermen of Nasugbu fishing in the vicinity of Fortune Island near the entrance to Manila Bay. Previously recorded by Herre from Miagao, Iloilo Province, Panay.

Family PRIACANTHIDÆ

Genus PSEUDOPRIACANTHUS Bleeker

PSEUDOPRIACANTHUS NIPHONIUM (Cuv. and Val.)

Several specimens were taken by trawl at the mouth of Manila Bay, in 65 fathoms. The only specimen measured was 143 mm. long. This is the first Philippine record of this fish, which was originally described from Japan. It is also known from Menado, Celebes, and from Reunion and Mauritius islands in the Indian Ocean.

Family APOGONIDÆ

Genus HOWELLA Ogilby

HOWELLA BRODIEI Ogilby Fig. 9.

A 58 mm. specimen was taken from the stomach of a dolphin (*Coryphæna hippurus* L.) which was caught in the Celebes Sea east of Tawi Tawi, Sulu Province; Lat. 5° 12′ North, and Long. 121° 57′ East.

First dorsal VIII; second dorsal I–9; anal 9; pectorals 14; caudal rays 18; spines above caudal base 7, below 7; 33 scales in lateral line with a ventral bend in the line between the 9th

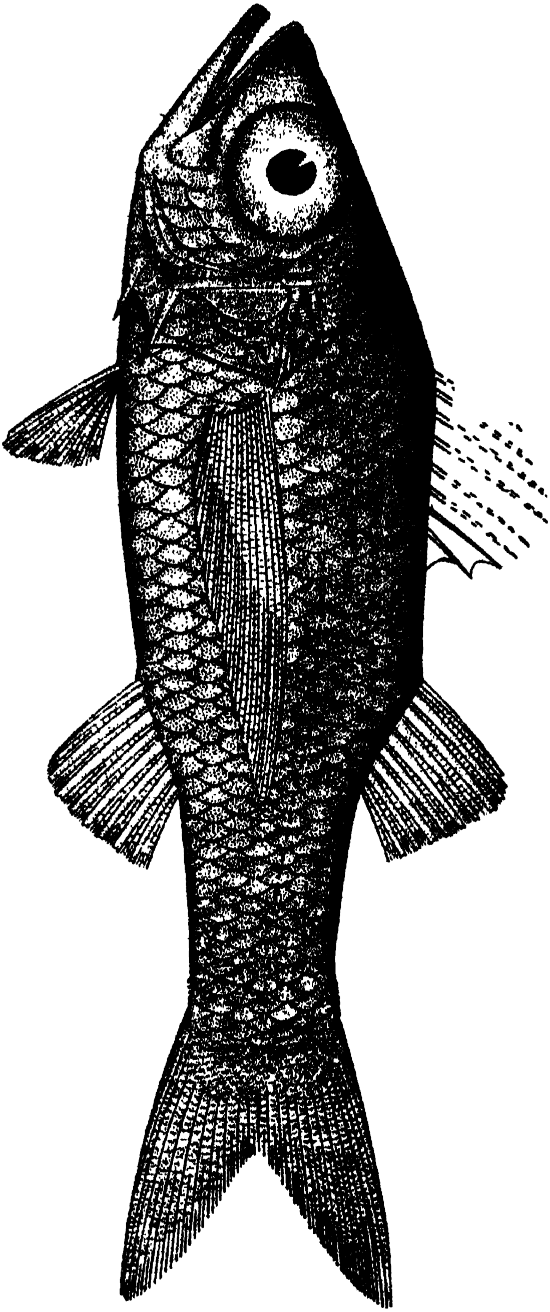

FIG. 9.

and 10th scales; gill rakers 7 + 1 + 19 = 27. Previously known only from Lord Howe Island east of New South Wales, Australia.

This species is likewise a very unexpected and surprising addition to the Philippine fish fauna.

Family SERRANIDÆ

Genus ANTHIAS Bloch

ANTHIAS ALBOFASCIATUS Fowler

Two examples, 57 and 72 mm. in length, were taken by otter trawl in the north entrance to Manila Bay. They were found in 27 to 31 fathoms of water near Los Cochinos Point, Bataan Province, November 25, 1947.

Previously known only from the type taken by the *Albatross* in the China Sea, northwest of Luzon and outside Philippine waters, and from two specimens collected by Herre at Puerto Galera, Mindoro.

Family NEMIPTERIDÆ

Genus NEMIPTERUS Swainson

NEMIPTERUS MARGINATUS (Cuvier and Valenciennes)

We have examined three specimens all about 145 mm. in length, from the north entrance to Manila Bay. They were caught in an otter trawl in 30 fathoms of water, off Los Cochinos Point, Bataan Province, November 25, 1947.

Previously known only from Java, Makassar and Bulukomba in Celebes, and Vanikolo, Santa Cruz Islands. New to the Philippines.

Family HISTIOPTERIDÆ

Genus HISTIOPTERUS Schlegel

HISTIOPTERUS TYPUS Schlegel Fig. 10.

A fine specimen 240 mm. long was taken by the M. V. *T. N. Gill,* 5 miles northwest of Fortune Island, Batangas Province. A second specimen was 93 mm. long.

This noteworthy find is the first record for this fish outside Japanese waters, where it is a food fish, but not abundant.

Family ANTIGONIIDÆ

Genus ANTIGONIA Lowe

ANTIGONIA MALAYANUS M. Weber

Many specimens up to 60 mm. in length were taken by otter trawl, worked by the M. V. *T. N. Gill,* in 60 fathoms. They were caught October 2, 1947, about 5 miles northwest of For-

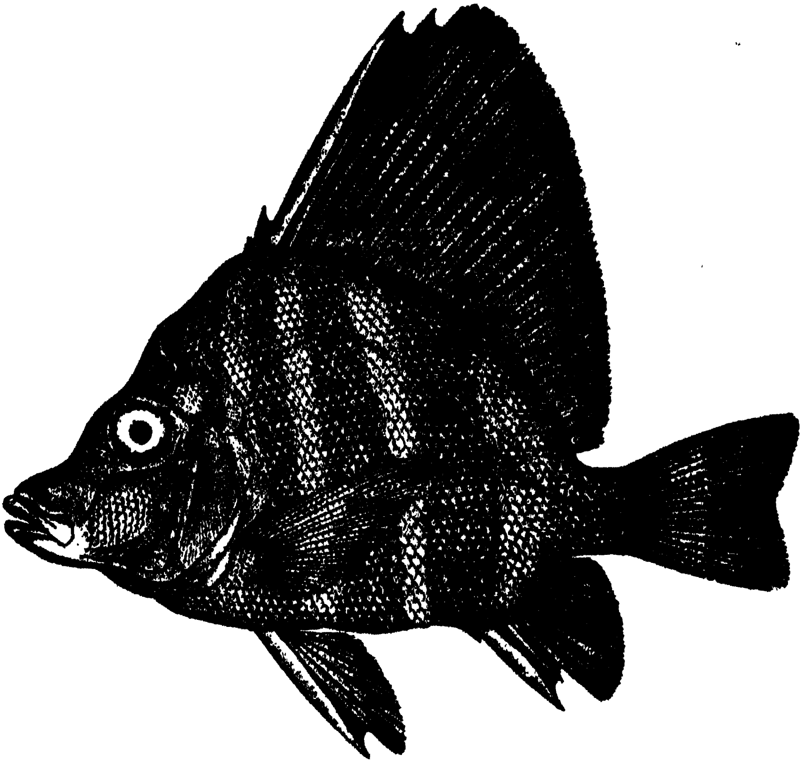

FIG. 10.

tune Island, Batangas Province, Luzon. Previously known only from the Arafura Sea; this is another fine addition to the Philippine fish fauna.

Family SCORPÆNIDÆ

Genus AMBLYAPISTUS Bleeker

AMBLYAPISTUS MACRACANTHUS (Bleeker)

A specimen 66 mm. long was taken by a beam trawler in Manila Bay, within 8 miles of Corregidor Island on June 27, 1947, in 13 to 25 fathoms of water. This is the first Philippine record of this rare fish, which has previously been known only from Amboina and Ceram, Dutch East Indies.

Genus APISTUS Cuv. and Val.

APISTUS ALATUS Cuvier and Valenciennes

A specimen 75 mm. long was taken by the otter trawl of the M. V. *T. N. Gill*, October 28, 1947. This addition to the Philippine fish fauna was caught 7 miles southwest of Corregidor

Island, off the coast of Cavite Province, Luzon. It was originally described from Madras and Bengal, India, and is also known from the coasts of China and Japan, and from Batavia, Java.

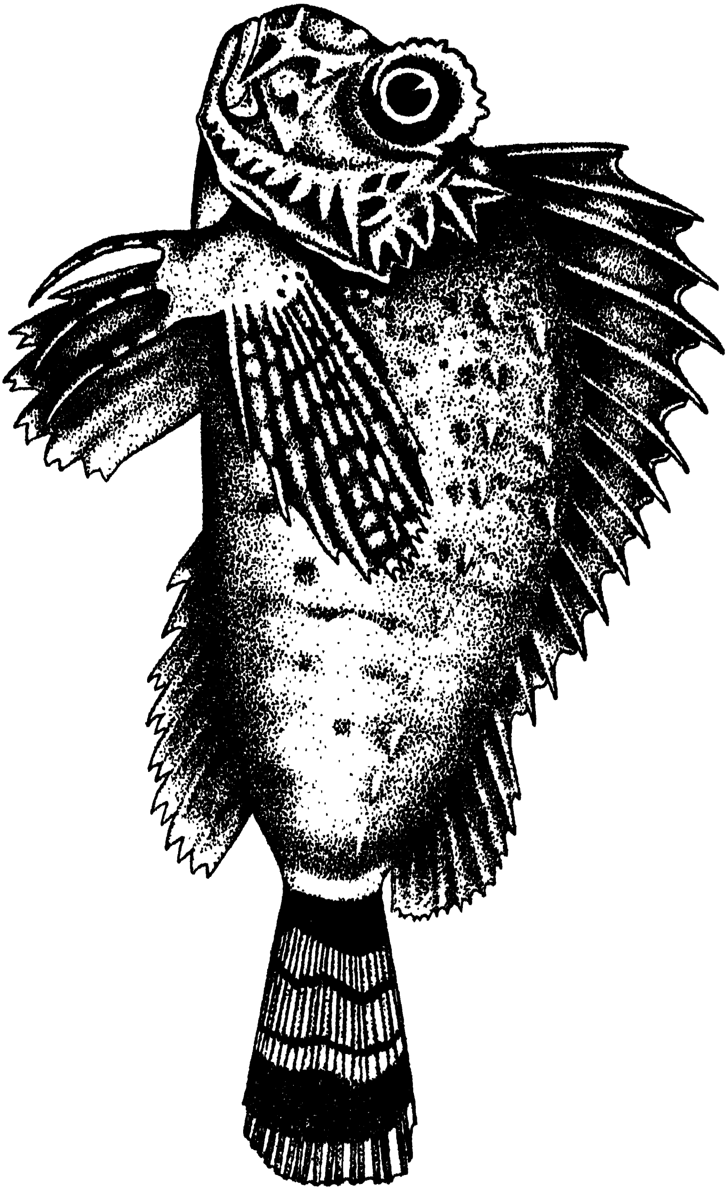

FIG. 11.

Family SYNANCEJIDÆ

Genus CHORIDACTYLUS Richardson

CHORIDACTYLUS MULTIBARBIS Richardson Fig. 11.

Two specimens, 57 and 60 mm. in length, were taken by beam trawl from Manila Bay within 8 miles of Corregidor Island, at a depth of 13 to 15 fathoms, June 27, 1947. New to the Philippines and only known previously from the coast of China and from Madras, India.

Genus INIMICUS Jordan and Starks

INIMICUS CUVIERI (Gray)

Five specimens 60 to 105 mm. in length were taken by beam trawl from Manila Bay near Corregidor Island, June 27, 1947; three more were caught in the same locality May 25, 1948. This fish has long been known from China, India, and Sumatra. This is the second Philippine record, the first being by Herre from Murcielagos Bay, Misamis Occidental Province, Mindanao, August, 1940.

Family PERISTEDIIDÆ

Genus PERISTEDION Lacépède

PERISTEDION WELCHI Herre

This species, originally described from Dumaguete, Negros Oriental Province, has since been discovered in Japan. The second Philippine specimen known was taken by the M. V. *T. N. Gill* with an otter trawl in 65 fathoms 5 miles northwest of Fortune Island, Batangas Province, Luzon, on October 2, 1947. Its length was 314 mm.

Family TRYPAUCHENIDÆ

Genus AMBLYOTRYPAUCHEN Hora

AMBLYOTRYPAUCHEN ARCTOCEPHALUS (Alcock)

Sixteen specimens 87 to 130 mm. in length were taken from Manila Bay in 19 to 29 fathoms, in the summer of 1947. This is the first Philippine record. Two examples were notable in that each had a large carcinoma on the side of the head. Previously known from the Arabian Sea, the Gulf of Martaban, the Sandheads at the mouth of the Hugli River, the Ganjam and Vizagapatam coasts of India, and the Bay of Bengal.

Genus CTENOTRYPAUCHEN Steindachner

CTENOTRYPAUCHEN MICROCEPHALUS Bleeker

Nine specimens 82 to 150 mm. in length were taken by trawl from Manila Bay between June and September, 1947, in 19 to 29 fathoms of water. This is the second Philippine record. Only the type from Borneo was known until the species was recorded from La Libertad, Negros Oriental Province, Philippines. Also known from the Andaman Islands and the Persian Gulf.

Genus TRYPAUCHENICHTHYS Bleeker

TRYPAUCHENICHTHYS TYPUS (Bleeker)

Previously known from the Philippines by a specimen from Cagayancillo, Cagayan Islands, Sulu Sea. A second specimen 110 mm. long was taken by the M. V. *T. N. Gill*, using an otter trawl in 15 fathoms of water, 9.7 miles northwest of Sangley Point, Cavite Province, Manila Bay. The type was taken in Borneo.

Family ECHENEIDÆ

Genus REMORA Forster

REMORA REMORA (Linnaeus)

A juvenile specimen 25 mm. long was taken from a sailfish, *Istiophorus orientalis*, caught while fishing by electric light in the Celebes Sea, Lat. 6° North, Long. 123° East, between Jolo and Cotabato Province, Mindanao. The senior author later obtained half a dozen specimens at Malampaya Sound, Palawan, in June, 1948, from 200 to 500 mm. in length. A common species on many kinds of sharks and bony fishes, and on marine turtles. Long known from the Philippines, but this is the first printed record. In all temperate and tropical seas.

Genus REMOROPSIS Gill

REMOROPSIS BRACHYPTERA (Lowe)

A specimen 64.5 mm. long was taken at Lat. 5° 20′ North and Long. 123° 7′ East, Celebes Sea. It was attached to an 85-pound shark which was caught at the surface. This is the first Philippine record. Several others were taken later in the Sulu Sea and elsewhere, but the data are not available. In all warm seas, north to Japan and Massachusetts.

Family XIPHASIIDÆ

Genus XIPHASIA Swainson

XIPHASIA SETIFER Swainson

The only previous Philippine record is by Herre, from Dumaguete, Negros Oriental Province. Six additional specimens are now listed, from 5 localities. One specimen with the tail broken off but the remaining part 332 mm. long, was taken by beam trawl from Manila Bay, June 27, 1947, in 13 to 25 fathoms. The damaged specimen has dorsal rays 116, anal rays 103. A specimen 228 mm. long was taken from the stomach of a yellow fin tuna, caught in Sibutu Passage, Sulu Province. Another specimen 169 mm. long was caught from the M. V. *S. F. Baird* while fishing with electric light in the Sulu Sea at Lat. 6° 48.5′ North and Long. 118° 51.5′ East, December 10, 1947; dorsal rays 122 anal rays 112. A specimen 236 mm. long was taken in the Sulu Sea while fishing with a light from the M. V. *T. N. Gill*, south of Pilas Island, between Basilan and Jolo Islands, April 13, 1948. Two specimens 280 and 247 mm. in length were purchased in the Batangas market, Batangas Province, Luzon, April 20, 1948. This fish is known from India to the Riu Kiu Islands.

Family CHÆNOPSIDÆ

Genus PHOLIDICHTHYS Bleeker

PHOLIDICHTHYS LEUCOTAENIA Bleeker

Two specimens of this very rare blenny, 111 and 123 mm. in length, were taken from Candaraman Inlet, off Albay Island, northeast of Balabac Island. They were caught by the aid of electric light, December 7, 1947.

Dorsal rays 75 and 77; anal rays 61; pectoral rays 14 on the smaller one, 15 on the larger; caudal rays 10. Depth 8.1 and 8.78, the head 6 to 6.9 times in the length. The snout is 4.94 to 5.14 times, the eye 5.96 to 5.56 times in the head. The smaller specimen has the following measurements: depth 13.7 mm.; head 18.5 mm.; snout 3.6 mm.; eye 3.1 mm. The other has the depth 14 mm.; head 17.8 mm.; snout 3.6 mm.; eye 3.2 mm.

New to the Philippines and only known previously from the island of Buru, Dutch East Indies.

Family CARAPIDÆ

Genus CARAPUS Rafinesque

CARAPUS PARVIPINNIS Kaup

Two examples, 125 and 315 mm. in length, were taken from a holothurian in 10 fathoms of water at Musa Bay, Fuga Island, Babuyanes Islands north of Luzon. First Philippine record. Widely distributed in Polynesia, ranging from the Society Islands to the Philippines.

Family MONACANTHIDÆ

Genus CANTHERINES Swainson

CANTHERINES TESSELLATUS Gunther

A specimen 147 mm. long was taken by otter trawl operated from the M. V. *T. N. Gill*, October 2, 1947, at a depth of 65 fathoms, off the west coast of Cavite Province, Luzon, outside the entrance to Manila Bay. This is the second Philippine record. The first record was by Günther in 1880; his specimen came from Banton Island in the Sibuyan Sea, Romblon Province. These two specimens are the only ones known.

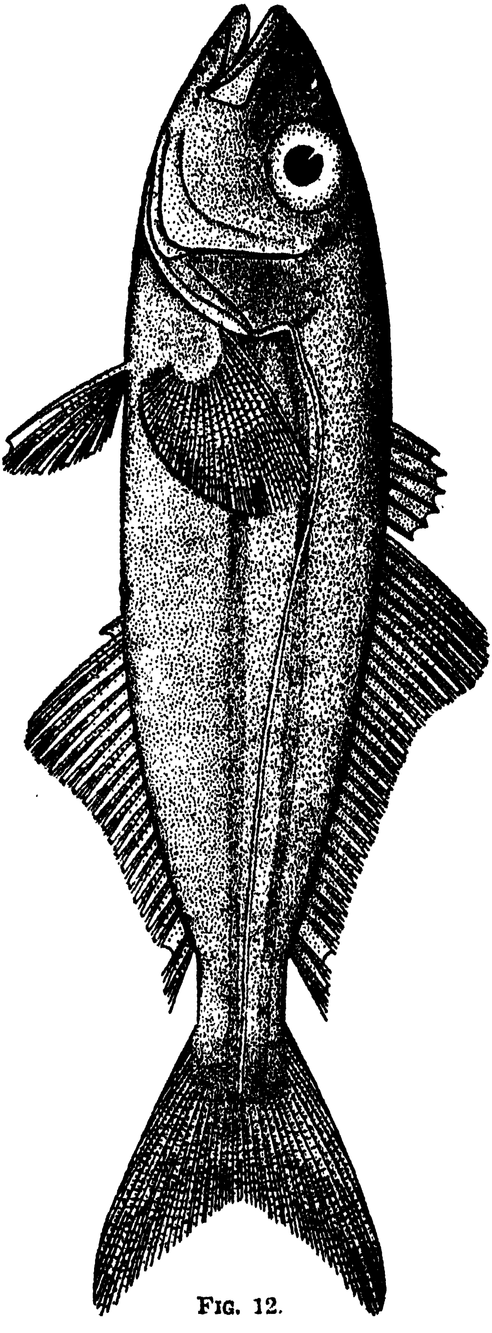

FIG. 12.

APPENDIX

NOTEWORTHY FISHES FROM AREAS ADJACENT TO THE PHILIPPINES

Family SCOMBRIDÆ

Genus SCOMBEROMORUS Lacépède

SCOMBEROMORUS KUHLII Cuvier and Valenciennes

One specimen 330 mm. in length was purchased in the market at Sandakan, British North Borneo on January 11, 1948. Since this locality is within a very few miles of Philippine waters, this species may undoubtedly soon be added to the Philippine Checklist. Munro has indicated in his revision of *Scomberomorus* (1943, p. 68) that *Scomberomorus guttatum* Kishinouye which has previously been recorded from other sections of Borneo is actually a synonym of *S. kuhlii.* Pertinent data on this specimen are as follows: dorsal XVI-20-9; anal 19-8; gill rakers 2 + 1 + 7 =10.

Family CARANGIDÆ

Genus ELAGATIS Bennett

ELAGATIS BIPINNULATUS Quoy and Gaimard Fig. 12.

At a Celebes Sea nightlight station, Lat. 2° North, Long. 123° East, there was obtained a 40 mm. fish which upon examination proved to be the youngest specimen known of this species. Even on this small specimen the blue and yellow lines which are so prominent on the adult rainbow runner, were vividly present. It will be noted that the characters of this juvenile fish are quite different from those of the adult. Although "salmon", as they are known in some parts of the Philippines, are quite common, the younger stages have not previously been available.

ILLUSTRATIONS

FIG. 1. *Umalius philippinus* n. g. and sp.; 126 mm.
2. *Diplophos tænia* Günther; 36 mm.
3. *Trachypterus misakiensis* Tanaka; 90 mm.
4. *Jordanidia prometheoides* (Bleeker); 168 mm.
5. *Istiophorus orientalis* Schlegel; 159 mm.
6. *Xiphias gladius* Linnæus; 41 mm.
7. *Nomeus gronovii* (Gmelin); 30 mm.
8. *Coryphæna equisetis* Linnæus; 19 mm.
9. *Howella brodiei* Ogilby; 58 mm.
10. *Histiopterus typus* Schlegel; 120 mm.
11. *Choridactylus multibarbis* Richardson; 57 mm.
12. *Elagatis bipinnulatus* Quoy and Gaimard; 40 m

SIX ADDITIONS TO THE PHILIPPINE FISH FAUNA, INCLUDING TWO NEW SPECIES

By Albert W. Herre
School of Fisheries, University of Washington

Further studies of my 1948 Philippine collections continue to make surprising additions to our knowledge of Philippine fishes. The specimens mentioned here were taken from Manila Bay, the Batangas coast, and Dumaguete. It was supposed that the fish fauna of Manila Bay was well known, but trawling near the entrance to Manila Bay has revealed many kinds of fishes whose presence was not suspected. When similar investigations are made in Ragay Gulf, the Gulf of Lingayen, and among the islands north of Luzon, we may expect many more additions, especially of fishes now only known from more northern waters.

PSENES EXTRANEUS Herre, new species

First dorsal XI; second dorsal II—14; anal III—15; pectoral 22; scales in lateral line about 55 but owing to their deciduous character the number is uncertain; gillrakers 6 plus 14.

The laterally compressed ovate body has the upper and lower profiles about evenly convex; the head is strongly convex, snout descending steeply to the small mouth; the lower jaw is projecting, the maxillary not extending to the eye. The depth is 2.4, the head 3.1, the pectoral 3.44 times in the length. The circular eye is 3.4, the short snout 3.8, the high convex interorbital 3.1 in the head. The preopercular margin is entire, the opercle without a definite spine. The first dorsal spine is very short and rather stout, the others all weak with elongate flexible tips; the fourth and fifth spines longest, a trifle more than half as long as the head or 6 times in the total length; first spine of second dorsal stout and very short, 3 times in the eye; second spine long, slender, 3.1 in head and higher than any of the dorsal rays. First 2 anal spines short and stout, the third much longer but weak, the anal rays like those of the dorsal. The basal half or two-thirds of the second dorsal and anal are covered with skin, leaving only the tips of the rays free. The pectoral extends to above the third anal ray. The ventral origin is definitely a little behind that of the pectoral; the ventral is 7.4 times in the length, its tip scarcely reaching the anus. The caudal is too badly broken to make measurements, but it was evidently deeply forked. The small scales are very deciduous, those of the lateral line larger and platelike; scales cover the basal half of the second dorsal and anal fins.

The color is more or less purplish gray, becoming yellowish on the head, with 6 vertical dusky cross bars, the first descending from the back to behind the pectoral, the last on the caudal peduncle; besides these there are dusky spots and irregular marks; the opercle is largely covered by a purplish black spot. The scales are silvery, and in life the whole fish must have had a brilliant silvery sheen. The dorsal and anal membranes are black or blackish; the pectorals are colorless, the caudal and ventrals yellow.

Here described from the type and sole specimen, 97 mm. long, purchased in the Batangas market and caught in Batangas Bay, Batangas Province, Luzon. It is almost scaleless and was badly handled by the fisherman, so that it is in poor condition. It is evidently closely related to *Psenes indicus* (Day). A large series might show it to be only a variation of *P. indicus*, but until more material is available the present disposition must stand. *Extraneus*, a stranger.

CHELIDOPERCA HIRUNDINACEA (Cuv. and Val.)

Centropristis hirundinaceus Cuv. and Val., Hist. Nat. Poiss. 7 (1931) 450, Japan; Schlegel, Fauna Japon., Poiss. (1842) 14, *plate 5, fig. 1*, Nagasaki.

Centropristis pleurospilus Günther, Reports *Challenger* Expd., Zoology 1 (1880) 37, *plate 16, fig. D*, part VI, Shore Fishes, Ki Islands.

Chelidoperca hirundinacea Boulenger, Cat. Fishes, ed. 2 1 (1895) 305, Japan and Arafura Sea, off the Kei Islands, Jordan and Richardson, Proc. U. S. Nat. Mus. 37 (1910) 464, Suruga Bay and Sagami Bay, Japan; Tanaka, Fishes Japan 12 (1912) 343, *plate 92, figs. 296–297*, Nagasaki to Tokyo

Known from Japan and the Ke Islands, south of New Guinea.

Three specimens of typical appearance, 53 to 105 mm. in length, were taken in the south entrance to Manila Bay. I find they do not agree with Boulenger's description, but are nearer to Günther's account cited above.

Dorsal X—10; anal III—6; scales 42 to 44, 3 or 3½ above and 11 or 12 below the lateral line; pectoral I—14, as in Günther's figure, not 17 as in Boulenger. Gillrakers 3 to 5 plus 8 or 9, with 4 more low rounded rudiments.

Color of preserved specimens reddish tan, with faint indications of 5 or 6 dorsal cross-bands; a row of 5 conspicuous black oblong spots above the middle of the side; in the smallest specimen they form an almost continuous line. There are faint traces of darker cross-bars on the spinous dorsal, the fins otherwise clear. Immediately behind the eyes is a conspicuous circular yellow spot. This species is apparently red in life.

With the above I place a specimen 71 mm. long, of uniform coloration, without the row of spots so conspicuous on the others. It also has a peculiar physiognomy; the snout is shorter and concave, instead of convex, as in all other specimens. The anterior teeth of the upper jaw project forward, and are exposed when the mouth is closed. Scales 42, with 2 above and 9 below the lateral line. The gillrakers are 2 plus 6.

In his generic diagnosis Boulenger mentions teeth "in the middle of the upper jaw enlarged, depressible, hinged at the bases. The enlarged teeth are conspicuous in all my specimens, but the teeth are fixed, not hinged or depressible.

NEMIPTERUS BALINENSIS (Bleeker)

Dentex balinensis Bleeker, Nat. Tijds. Ned. Ind. 17 (1858–59) 155, Boleling, Bali; Bleeker, Atlas Ichth. 8 (1876–77) 95, *plate 327 fig. 4*, Bali.

Synagris balinensis Fowler, U. S. Nat. Mus. Bull. 100, 12 (1933) 103, after Bleeker.

Nemipterus balinensis Weber and de Beaufort, Fishes Indo-Austr. Arch. 7 (1936) 385, Bali.

A very rare East Indian species now made known from the Philippines for the first time.

I refer here a specimen 84 mm. long, taken off the coast of Cavite Province, Luzon, in the south entrance to Manila Bay. It was dredged in about 60 fathoms.

Dorsal X—9; anal III—7; scales in lateral line 47, plus 2 or 3 on the caudal base; 3 above and 10 below the lateral line; gillrakers 5 + 12.

The depth is 3.9, the head 3.23, the caudal 4 times in the length, omitting the filament on the upper lobe of the caudal. The large eye is 2.8, more than the blunt snout, which is 3.7 in the head or 1.4 times in the eye. The flat interorbital space is rather wide, 1.5 in the eye. The maxillary reaches to beyond the front margin of the eye, 3 times in the head. Small caniniform teeth in the upper jaw, but none in the lower jaw. The suborbital is very narrow, its depth 4.5 times in the vertical diameter of the eye. The hind border of the preoperculum is plainly denticulate. The dorsal spines are rigid and sharp, the membrane between them scarcely emarginate; the soft dorsal rays approximately equal to the spinous part in height. The pointed pectoral is nearly 5 times in the length, its upper middle rays longest. The upper lobe of the deeply forked caudal ends in a filament, as in Bleeker's figure.

The color in alcohol is reddish brown, with a yellow band about as wide as the pupil along the middle of the side; fins colorless.

Bleeker's type was 151 mm. long.

Bali is the only other locality where this fish has been taken.

EVIOTA DISTIGMA Jordan and Seale

Eviota distigma Jordan and Seale, Fishes Samoa, Bur. Fish. Bull. **25** (1906) 389, *fig. 79,* Pago Pago, Samoa; Fowler and Silvester, Marine Papers Carnegie Inst. (1922) 125, Pago Pago; Fowler, Fishes Oceania, Mem. Bishop Mus. **10** (1928) 395, Pago Pago; Herre, Zool. Ser. Field Mus. Nat. Hist. **21** (1936) 348, Papeete, Tahiti; reef near Suva, Fiji.

Originally described from Samoa and widely distributed in Polynesia. Now reported for the first time from the Philippines.

A specimen 15 mm. long of this obscure little inhabitant of coral crevices was taken from a coral head at Dumaguete, Negros Oriental Province.

NEOPERCIS TESSELATA Herre, new species

Dorsal V—22; anal 18; scales in the lateral line 58 plus 4 or 5 on the caudal base, 5 above and 12 below the lateral line.

The breadth of the slender elongate body equals or is slightly more than the depth, which is 6.88 times in the length. The head is large, 3.25 in the length. The elongate convex snout is 3.27 in the head, the lower jaw protruding. The eye is prominent, impinging on the upper profile, 3.6, the maxillary 2.57 times in the head. The interorbital is 2.22 in the eye or 8 times in the head. The mouth is large, the maxillary extending beneath the anterior third of the eye; 2 strong curved canines at the front of the upper jaw and four in the lower jaw. Pectoral somewhat rounded, 5.57, the nearly truncate caudal 5.85 times in the length; the ventral reaches the anal. All scales are ctenoid.

Spinous and soft dorsals deeply divided, the fourth spine longest, 4.5 in the head; soft dorsal rays of nearly uniform height, middle and posterior rays 2.57 times in the head; anal of nearly uniform height, a little lower than the soft dorsal, longest rays 3 in the head. Least depth of the caudal peduncle 1.25 times in its own length or 4.5 in the head.

Color in alcohol reddish brown, with traces of 5 (6?) broad double blackish cross-bands over the back and sides; each scale above the lateral line is margined with black, giving a tessellated appearance; a dusky spot above the middle of the caudal base and the posterior fourth of the middle caudal rays blackened; spinous dorsal vaguely barred with darker; fins otherwise colorless, though the soft dorsal has indications of having been lightly barred.

Herre described from the type and only specimen, 117 mm. long, taken by commercial trawl in Manila Bay, 16 kilometers north-east of Corregidor. This is the first Philippine record of the genus *Neopercis*, distinguished by having teeth on the palatines.

Tessellatus, checkered, in allusion to the appearance of the back.

CHAMPSODON ARAFURENSIS

Champsodon arafurensis Regan, Trans. Linnean Society, ser. 2, Zoology 12 (1908) 245, "Arafura Sea and Ki Islands", at 129 fahtoms; Weber, Max *Siboga* Exped. Fische 57 (1913) 146, Madura Strait and Sea; Bima; Buton Strait; Timor Sea; near Waigiu.

Originally known from the Arafura Sea and Kei Islands, and later from the East Indies, it is now reported from the Philippines for the first time. Lives on sandy and muddy bottom. Taken at various depths from 8 meters to 141 meters.

First dorsal IV or V; second dorsal I—19 to II—17; anal I—17 or 18? Gillrakers 2 + 8 to 10.

Depth 4.8 to 5.5, head 3.4 to 3.6 times in the length. The eye is 4.8 to 5 times in the head and is more than the interorbital. The maxillary extends well beyond the eye, its length 1.75 to 1.5 times in the head. The ventrals extend to the origin of the anal. The preopercular spine does not extend to the ventral origin. Between the occiput and caudal are about 24 transverse lines which are branches of the two lateral lines.

The color in alcohol is reddish brown, the back and sides often more or less sprinkled with black dots. In the smallest specimens these form 5 or 6 short transverse black bands over the back, the bands disappearing with age. Some specimens also have the abdomen sprinkled with black dots. When specimens are removed from alcohol and dried a little the scales become brilliant silvery, while the transverse lines become conspicuous, the longitudinal lateral lines less evident.

Six specimens, 31 to 50 mm. in length, were taken in the south entrance to Manila Bay, off the coast of Cavite Prov., in 65 fathoms. A specimen 48 mm. long was much bulkier than any others. A specimen 56 mm. long was taken in Manila Bay, in 17 to 25 fathoms, about 10 miles northeast of Corregidor.

Descriptions of ten species of *Champsodon* have been examined. Several of them are very close and their status is doubtful. They need to be revised with ample material available for comparative study. In that event several would probably be relegated to synonymy. The above disposition is not completely satisfactory, but is the best that can be made at present.

BOOKS

Books reviewed here have been received by The Philippine Journal of Science from time to time and acknowledged in this section.

REVIEW

Analytic geometry. By Clyde E. Lowe. 4th ed. New York, The Macmillan company, 1948. 306p., illus. Price ₱7.00.

The author is a well-known professor of mathematics and his text should receive the attention of teachers on his favorite subject. Analytic Geometry is presented as stated in the preface "to make the text easier reading for the student". In it the author proves well his objective. It is doubtful whether any book on the subject could be written with such clearness and conciseness without sacrificing any of the important parts. The chapters covered are those usually found in any textbook of this nature. There are others, like Chapters IX, XVI and XVII which increase the usefulness of the text. The book is not only an excellent text for a course in analytic geometry but also a good reference for those who already took the subject and wish to refresh their knowledge of the subject.—G. O. O.

Calculations of quantitative analysis. By Philip W. West. New York, The Macmillan company, 1948. 162p. Price ₱5.50.

In this book the author had in mind to impart to the student a thorough training in the methods of analytic calculations which provides in turn a more fundamental understanding of the underlying principles of the various analytical determinations studied. The book was written in lecture style and sufficient examples are included to enable the student to see how each typical problem should be approached. The problems selected were chosen from standard elementary quantitative chemical analysis text-books, some of which have direct bearing on industrial applications from such fields as metallurgy, geology and water analysis. Likewise sufficient information is given to enable the student to understand the principles of the determinations involved and the nature of the procedures. This book is certainly a tool for an easy grasp on this practical branch of chemistry.—L. G. A.

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READJUSTMENTS IN THE NOMENCLATURE OF PHILIPPINE EUGENIA SPECIES

By E. D. MERRILL
Of Harvard University

Eugenia Linn. has been treated by most authors, following the Bentham-Hooker f. interpretation, General Plantarum 1 (1865) 718, as a collective genus enormously developed in the total number of species in the tropical and subtropical parts of both hemispheres. The number of binomials actually published under this generic name approximates 2,600 and new ones are constantly being proposed. This of course, does not mean that there are now 2,600 distinct species in this protean genus (or rather, in the current interpretation of it *sensu latiore*), for a complicated synonymy is involved. Many proposed species have been reduced as synonyms of earlier described ones. However, the number of distinct species is very large, and the vast number of already published binomials clearly indicates to systematists the difficulties which any student may be expected to encounter, whether he be a widely experienced individual or merely a beginner, and whether he be concerned with generic or merely with specific limits.

Most authors naturally accept the weight of authority, and thus it is that those who still elect to follow the Bentham-Hooker f. system accept *Eugenia* Linn. as they interpreted it. These two eminent botanists actually reduced to *Eugenia* approximately 37 genera that had been proposed by this or that author for this or that Old World or New World group. With their wide concept the number of generic synonyms would now be in excess of 40 if the published reductions of *Aphanomyrtus* Miq. (*Pseudoeugenia* Scort.), *Paraeugenia* Turrill, and *Tetraeugenia* Merr. to *Syzygium* Gaertn. be accepted, for the latter in the Bentham-Hooker f. concept is in turn a synonym of *Eugenia* Linn.

Niedenzu, in his treatment of the Myrtaceae, Engler and Prantl, Nat. Pflanzenfam. 3(7) (1891) 78–86, restricted *Eugenia* Linn. as almost wholly limited to the tropical American species. He placed the great bulk of the Old World *Eugenia* species in *Syzygium* Gaertn. and *Jambosa* DC., neither of these having any representatives in the New World except as this or that species has been deliberately introduced. The American *Eugenia* Linn. was subdivided into two subgenera, twelve sections, and three subsections, and the only admitted Old World species was a small group that he designated as subgen. *Eueugenia*, sect. *Jossinia*.

Here and there modern authors concerned with Old World species have accepted *Syzygium* Gaertn., *Jambosa* DC., and at least one (Diels) also *Jossinia* Commers. Few in recent years have gone beyond this limited segregation, although Guillaumin in 1939 recognized for the New Caledonian representatives of the group, *Eugenia* Linn. about 30 species (all apparently belonging in *Jossinia*), *Jambosa* DC., 8 species, *Syzygium* Gaertn., 27 species, and finally *Caryophyllus* Linn., 14 species. I have been content to retain the *Caryophyllus* species under *Syzygium* Gaertn., as have other modern authors who have accepted this or that proposed generic segregate. He also recognized *Acicalyptus* A. Gray, which Dr. Perry and I, correctly we believe, placed as a synonym of *Cleistocalyx* Blume.[1]

In our studies of this complex group, covering the genera and species of the Old World tropics, with special attention to those of China, Indo-China, Borneo, New Guinea, Fiji, and now the Philippines, we have been content to recognize as worthy of generic rank, one very large Old World genus, *Syzygium* Gaertn. (including *Jambosa* DC. and *Caryophyllus* Linn.), and several much smaller groups, *Cleistocalyx* Blume (including *Acicalyptus* A. Gray), *Acmena* DC., and now, following Diels, I recognize *Jossinia* Commerson. In his extensive studies of this *Eugenia* complex for the species of New Guinea, the Solomon Islands and Micronesia, Diels also recognized *Jambosa* DC. as worthy of generic status coordinate with *Syzygium* Gaertn. While it is admitted that the extreme forms of the *Jambosa* assemblage, with medium to large flowers, spreading petals, and large calyx lobes do appear to be sufficiently distinct from the normally small flowered *Syzygium* species wherein the calyx lobes are usually short or very short, and the concave petals are closely imbricate, sometimes even cohering, and usually falling as a sort of calyptra, rather than spreading, we have felt that there are too many intermediate forms to warrant the acceptance of *Jambosa* DC., as a distinct genus. Although I still prefer to retain *Jambosa* DC. as a synonym of *Syzygium* Gaertn., perhaps after all it is as distinct from *Syzygium* Gaertn., as is *Syzygium* Gaertn. from *Eugenia* Linn., or as are *Cleistocalyx* Blume, *Acmena* DC., *Jossinia* Commers., and even *Caryophyllus* Linn., *Aphanomyrtus* Miq. (*Pseudoeugenia* Scort.), *Tetraeugenia* Meer., and *Paraeugenia* Turrill, from *Syzygium* Gaertn.

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[1] Guillaumin, A. Bull Soc. Bot. France 85 (1938) 626–655.

In addition to the Bornean study of 156 species of 1939 referred to below under *Syzygium* there are two recent detailed studies of this group for parts of the Malaysian region, first the Amshoff[2] treatment of the Javan species for which island she recognized *Eugenia* Linn., with one introduced species (*Eugenia uniflora* Linn.), *Cleistocalyx* Blume, with one species, *Aphanomyrtus* Miq., with one species, *Acmena* DC., with two species, and *Syzygium* Gaertn. (including *Jambosa* DC.), with fifty species. The contrasting one is Henderson's[3] detailed consideration of the species of the Malay Peninsula, in which he recognized 138 species, all retained under *Eugenia* Linn. *sensu latissimo*. His major divisions for the genus for the Malay Peninsula are four sections, § *Syzygium*, which for key purposes is subdivided into five unnamed groups covering 134 species and various varieties; § *Acmena*, with one species, § *Cleistocalyx*, with one species and § *Fissicalyx*, a new section with two species. This is strictly the conventional Bentham-Hooker f. concept, which for practical purposes is really much simpler than any other system yet proposed.

It may be argued that inter-relationships in groups above the species limits, such as the genus, may as readily be indicated by the acceptance of a broad generic concept and with the recognition of subgenera, sections, and other minor categories. In any case it is quite evident that there is, as yet, no approach to unanimity among those who have studied this group as to what constitutes a genus, or as to generic limits.

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[2] Amshoff, G. J. H. Myrtaceae, in Backer, C. A. Beknopte Flora van Java Afl. 4B (I) (1944) 1–39; Blumea 5 (1945) 495–501.

[3] Henderson, M. R. The genus Eugenia (Myrtaceae) in Malaya. Gard. Bull. Singapore 12 (1949) 1–293, *fig. 1–64.*

I am by no means satisfied in this study that all of my conclusions, as to the limits of this or that species, are correct, that all of the indicated reductions will stand the test of time, or that all of the recognized species will prove to be valid ones. I have merely done the best that I could with the material at present available to me. The deliberate burning of the Manila herbarium (Philippine National Herbarium), February 9, 1945, by the Japanese in the course of the fighting which resulted in the re-occupation of the city of Manila, proved to be a tremendous handicap, for the holotypes of some thousands of species described in Manila from 1904 to 1940 were thus lost. I have, accordingly, been obliged to rely on distributed duplicates and on published descriptions. Distributed duplicates are by no means always correctly named, although in a high percentage of those sent out from Manila the names are correct. In the case of several species I have been unable to locate authentically named specimens, and have had to depend on the published descriptions.

In the course of this study I have depended very largely on the material preserved in the Gray Herbarium and in the herbarium of the Arnold Arboretum, supplemented by the loan of all the unnamed Philippine specimens in the United States National Herbarium, the British Museum of Natural History, and the Royal Botanic Gardens, Kew. Representatives of selected species were also borrowed from the first of the above institutions. The receipt of the study set of the collections made under the auspices of the Philippine National Museum has been of very material assistance; it was my attempt to name this material that induced me to turn my attention to the Philippine representatives of this *Eugenia* complex. I am greatly indebted to those in authority who approved my requests for loans, to Mr. M. R. Henderson, Director of the Botanic Garden at Singapore, who very courteously provided some representation of nearly all of the species of the Malay Peninsula which were not already represented in our collections, and to Dr. Eduardo Quisumbing, for sending to me a most important set of duplicates of the current collections made since 1945. A very high percentage of all the described Philippine species of *Syzygium,* including very many holotypes and isotypes, are fortunately represented in the collection available to me for study.

The types of the 19 new species described in this paper are, unless otherwise stated, deposited in the herbarium of the Arnold Arboretum.

XANTHOMYRTUS Diels

XANTHOMYRTUS DIPLYCOSIFOLIA (C. B. Rob.) Merr.

Xanthomyrtus diplycosifolia (C. B. Rob.) Merr., Philip. Jour. Sci. 30 (1926) 415.

Eugenia diplycosifolia C. B. Bot. Rob., op. cit. 4C (1909) 347; Merr., Enum. 3 (1923) 165.

Eugenia aurea Elm., Leafl. Philip. Bot. 4 (1912) 1400; Merr. op. cit. 158, *syn. nov.*

Xanthomyrmex aureus Merr., Philip. Jour. Sci. 30 (1923) 415, *syn. nov.*

Higher mountains of the Philippines from northern Luzon to Negros and Mindanao. Endemic. With seventeen individual collections now available for examination, including nine recent ones from Mount Polis in northern Luzon and the mountains of Mindanao (*P. N. H. 7795, 7914 Celestino, 1049, 1051, 1064, 1569 Edaño, 10780, 10809 Mendoza* and *Convocar, 9985 Sulit,* I conclude that a single species is represented.

This Philippine species is apparently most closely allied to the Papuan *Xanthomyrtus fasciculata* Diels. The genus is essentially a Papuan one with nineteen species now known from New Guinea, three in Borneo, two in New Caledonia, and apparently one in northeastern Australia. *Xanthomyrtus* Diels belongs in the Myrtinae, not in the Eugeniinae.

EUGENIA Linnaeus

In a strict sense there is only one species of this genus known from the Philippines, this being the introduced *Eugenia uniflora* Linn. (*E. michelii* Lam.), native of Brazil. It is known as "pitanga," its Brazilian name, and as the "Cayenne cherry." It was introduced into Ceylon and India by the Portuguese at an early date, and from Goa it was introduced into Italy. It was first illustrated in European literature by Tilli in 1723 and a little later by Micheli in 1729, from specimens cultivated in Italian gardens. The references to Tilli and to Micheli are included in the original Linnaean consideration of the species, and Linnaeus saw the Flora Zeylanica specimen. While it is true that Linnaeus in 1753 included in *Eugenia* two species which belong in *Syzygium* Gaertner (including *Jambosa* DC.) and two species of the lecythidaceous genus *Barringtonia* Forst., his generic description from the first edition of his Genera Plantarum (1737) to the last one issued by him was based wholly on Micheli, and he cites Micheli as the author of the genus, as well as is the case in all later editions of the Genera Plantarum by other authors. It was, hence, entirely logical that *Eugenia uniflora* Linn. should have been selected as the type or standard species of the genus, rather than either of the Old World species of *Syzygium* (*Eugenia malaccensis* Linn. and *E. jambos* Linn.) included in the first edition of the Species Plantarum.

Berg, Linnaea 27 (1854) 309, proposed and described the genus *Stenocalyx* Berg, publishing under it 41 binomials; but here, were one to select a type or standard species, it should logically be *stenocalyx michelii* Berg = *Eugenia micheli* Lam. = *Eugenia uniflora* Linn. Thus *Stenocalyx* Berg is an exact synonym of the earlier *Eugenia* Linnaeus, for the benefit of those who would segregate minor generic groups from the now unwieldy *Eugenia* complex. Most of the numerous Philippine *Eugenia* species are now referred to *Syzygium* Gaertner, a few to other genera as indicated below.

EUGENIA UNIFLORA Linn.

Eugenia uniflora Linn., Sp. Pl. (1753) 471; Merr. and Perr. Jour. Arnold Arb. 19 (1938) 203.

Eugenia michelii Lam., Encycl. 3 (1789) 206.

Stenocalyx michelii Berg, Linnaea 27 (1854) 310, *cum syn.*

Eugenia decidua Merr., Philip. Jour. Sci. 9C (1914) 121, (type from Guam.

LUZON, Benguet Subprovince, Mount Santo Tomas, *P. N. H. 2178 Quisumbing*, Feb. 10, 1948, "grasslands on plateau, alt. 2,200 m."; Laguna Province, College of Agriculture, planted, *P. N. H. 8132 Sulit*, with the Brazilian name "pitanga."

As noted above this species was introduced into the Old World at an early date by the Portuguese in connection with their transmission of economic plants from Brazil to India, and vice versa, in the early colonial period. I have no record as to when the species was introduced into the Philippines; I had seen no specimens up to 1940 from the islands. If the field note on the above cited specimen is correct, it is apparent that the species has now become naturalized.

JOSSINIA Commerson ex De Candolle

Following my present inclination I have disposed of most of the numerous described Philippine species of *Eugenia* by transferring them to *Syzygium* Gaertner, with a few placed in *Acmena*, *Cleistocalyx*, and *Xanthomyrtus*. There was a small residue which, for a time, I was disposed to retain in *Eugenia*

Linnaeus, because this small *Jossinia* group resembled certain of the American *Eugenia* species much more closely than they did the Old World representatives of *Syzygium*. After due consideration I decided to follow Diels in this matter and to recognize *Jossinia* Commerson ex De Candolle as worthy of generic rank for this particular group.

The genus was first characterized by De Candolle (who accepted Commerson's name), Prodr. 3(1828) 237 (err. typ. 337), to take seven species from the Mascarene Islands and one from Madagascar. Blume later accepted the name, Mus. Bot. Lugd.-Bat. 1 (1849) 119–125, increased the number of species to seventeen, and extended the generic range to India, Celebes, the Moluccas, and New Guinea. Whether considered as a proper genus or as a subdivision of *Eugenia*, the range of the group is considerably wider than has hitherto been indicated, as representatives occur in tropical Africa, northeastern Australia, and throughout the Pacific region eastward to Hawaii, Tahiti, and Marquisas Islands. Thirty nine binominals have been published under this generic name. Those who have followed the Bentham-Hooker f. concept of *Eugenia* as a collective group and Niedenzu's somewhat narrower interpretation (excluding the *Syzygium-Jambosa* complex), naturally reduced *Jossinia* to *Eugenia*. In recent times Diels reinstated *Jossinia* for several species from New Guinea, Moluccas, Aru, Key, Caroline, and the Marianas Islands, Bot. Jahrb. 56 (1921) 531, op. cit. 57 (1922) 376–377, Jour. Arnold Arb. 10 (1929) 82. In 1921 he briefly discussed *Jossinia* as a genus, as follows:

> Den übrigen Formenkreisen der papuasischen *Eugeniinae* gegenüber muss *Jossinia* im Sinne Blumes getrennt behalten werden. Sie ist davon verschieden durch den Blütenstand (Einzelblüten in den Achseln kleiner Bracteen an getauchten oder auswachsenden Kurztreiben), durch das kurze Receptaculum mit grossen Kelchlappen und diskusartig erweiterem, die Staubblätter tragendem Scheitel, sowie durch die in der Knospe schlängelig eingekrümmten, nicht ± scharf geknickten Staubblätter. *Jossinia* scheint näher verwandt zu sein mit amerikanischen Formenkreisen als mit *Jambosa* und *Syzygium*."

A. Gray, Wilkes U. S. Explor. Exped. Bot. 1 (1854) 509, concerned himself with this *Eugenia* complex, stated that at first he was strongly disposed to accept the segregates *Jambosa*, *Syzygium* and *Acmena* as defined by De Candolle. But after considering also the proposals of Blume in *Gelpkea*, *Strongylocalyx*, *Jambosa*, *Clavimyrtus*, *Microjambosa*, and *Jossinia*, he decided that it would be necessary either to increase the number of proposed genera, or to retain *Eugenia* in the conventional wide sense that most authors have since followed; he chose the latter course. He noted that *Jossinia,* as defined by Blume, would fall in *Eugenia* except for the thick testa of the seed. He mentioned Wight's statement that *Jossinia* seeds have foliaceous cotyledons, but called attention to the fact that the seeds of the original *Jossinia* species do not appear to be known. I have not been able to examine the Mascarene specimens on which the original description of the genus was based. In accepting *Jossinia* I have assumed that the group, as characterized by Blume in 1849, is the same as that originally defined by De Candolle in 1828; but it should be noted that Diels specifically mentioned that he accepted the group as defined by Blume. I note in passing that when Niedenzu accepted and defined *Jossinia* as a section of the subgenus *Eugenia* his definition "Blüthenstand endstandig, racemos, beblattert" is not good, for in the typical species the flowers are solitary, paired, or fascicled, mostly axillary, sometimes terminal or subterminal. All of the species which I here consider have axillary, sometimes subterminal, solitary, paired, or fascicled flowers, these pedicelled or sessile. In none of the Philippine species is the inflorescence compound and branched as is the case in most of the *Syzygium* species; there are in the *Jossinia* range various species with racemose flowers. In addition to the often cushion-like disk and the large calyx lobes which are free to the base, i.e., with no extension of the tube above the ovary, as is the case in *Syzygium,* the pedicels and sepals are often sparingly pubescent, while with the exception of a very few *Syzygium* species, that large group is characteristically entirely glabrous. The Philippine representatives of *Jossinia* are:

JOSSINIA AHERNIANA (C. B. Rob.) comb. nov.

Eugenia aherniana C. B. Rob., Philip. Jour. Sci. 4C (1909) 344; Merr., Enum. 3 (1923) 157.

Eugenia melastomoides Elm., Leafl. Philip. Bot. 4 (1912) 1429; Merr., op. cit. 171, *syn. nov.*

This is one of the most widely distributed Philippine species extending from northern Luzon to southern Mindanao, and is now also known from Celebes. Twenty-two individual collections are now available to me, which for the most part represent distributed duplicates of early collections all correctly named; two recent collections are *P.N.H. 9568 Navarro, 9612 Mabesa* from Mount Maquiling, Laguna Province, Luzon. I can detect no characters by which *Eugenia melastomoides* Elm. may be distinguished from the form Robinson characterized and do not hesitate in reducing it to synonymy. The one Celebes collection available to me is *Netherl. For. Serv. 17160.*

JOSSINIA BRACHIPODA sp. nov.

Arbor parva, floribus exceptis glabra, ramis ramulisque pallidis, teretibus, ultimis 1–1.5 mm. diametro; foliis subellipticis vel elliptico-obovatis, 4–5.5 cm. longis, 2–3 cm. latis, coriaceis, breviter petiolatis, rotundatis vel latissime breviter rotundato-acuminatis, basi acutis, margine leviter revolutis, supra subolivaceis, subtus pallidis, utrinque obscurissime puncticulatis, vix nitidis nervis primariis utrinque circiter 7, gracilibus, inconspicuis, in venam intramarginalem 1 mm. a margine confluentibus, secundariis reticulisque obscuris; petiolo 2–3 mm. longo; floribus axillaribus, solitariis vel binis, sessilibus vel subsessilibus, plus minusve pubescentibus, saltem 2 cm. diametro (petalis ignotis), calycibus extus leviter pubescentibus, tubo lato, circiter 3 mm. longo, sursum ampliato, sepalis 4, glanduloso-punctatis, extus consperse pubescentibus, liberis, suborbiculari-ovatis, rotundatis, plus minusve concavis, binis circiter 5 mm. longis et 6 mm. latis, alteris 6 mm. longis et 7 mm. latis; petalis ignotis; staminibus numerosis, filamentis 1 cm. longis; stylo 1 cm. longo; disco incrassato, leviter pubescenti, 6 mm. diametro.

MINDANAO, District of Zamboanga, Santa Maria, *Bur. Sci. 16403 Reillo,* Sept.–Oct., 1912, type in the Gray Herbarium, isotypes in the U. S. National and British Museum herbaria.

Among most of the Philippine species this is distinguished by its sessile flowers, and while several of the other described Philippine species do have sessile flowers, they differ totally in their vegetative characters; among these it is apparently most closely allied to *Eugenia sargentii* Merr.

JOSSINIA HETEROPHYLLA (Merr.) comb. nov.

Garcinia heterophylla Merr., Philip. Jour. Sci. 12C (1917) 285, Enum. 3 (1923) 84.

LUZON, Nueva Ecija Province, *Bur. Sci. 26457 Ramos* and *Edaño.* Known only from the type collection, my attention having been called to my original error by Mr. H. K. Airy Shaw, Royal Botanic Gardens, Kew.

JOSSINIA KAMELII (Merr.) comb. nov.

Eugenia kamelii Merr., Philip. Jour. Sci. 10C (1915) 219; Enum. 3 (1923) 168.

A *Jossinia* with unusually large leaves. The species is still known only from the original collection, *Bur. Sci. 17539 Ramos,* from Samar, there being an excellent specimen of this in the U. S. National Herbarium. Its alliance is clearly with *Eugenia tulanan* Merr.

JOSSINIA LOHERI (C. B. Rob.) comb. nov.

Eugenia loheri C. B. Rob., Philip. Jour. Sci. 4C (1909) 345; Merr., Enum. 3 (1923) 169.

A typical *Jossinia*, still known only from the two original collections, *Cuming 1388, Loher 2475*, from Nueva Ecija and Pampanga provinces, Luzon.

JOSSINIA MONTALBANICA (Merr.) comb. nov.

Eugenia montalbanica Merr., Philip. Jour. Sci. 30 (1926) 417.
Eugenia diospyrifolia Merr., op. cit. 27 (1925) 39, non Wall.

A species still known only from the three original collections on which it was based, all in fruit, *Loher 13307, 13328, 14879*, from the mountains back of Montalban, Rizal Province, Luzon. It is possible that when flowers become available some other generic disposition of this species may be indicated.

JOSSINIA PASACAENSIS (C. B. Rob.)

Eugenia pasacaensis C. B. Rob., Philip. Jour. Sci. 4C (1909) 346; Merr., Enum. 3 (1923) 173.

Known only from the type collection, *For. Bur. 10467 Curran*, from Pasacao, Camarines Province, Luzon. A typical *Jossinia*.

JOSSINIA SARGENTII (Merr.) comb. nov.

Eugenia sargentii Merr., Philip. Jour. Sci. 18 (1921) 290; Enum. 3 (1923) 177.

Cagayan, Zambales, Pampanga, Batangas, and Rizal provinces, Luzon, and with some doubt, Ticao Island. An additional collection to those previously cited is *Loher 12399* from Rizal Province, Luzon.

JOSSINIA TULANAN (Merr.) comb. nov.

Eugenia tulanan Merr., Philip. Jour. Sci. 11C (1916) 201; Enum. 3 (1923) 179.

Originally described from two Samar collections. I now refer here the following additional collections: LUZON, Rizal Province, *Bur. Sci. 29267, 29391 Ramos* and *Edaño* (erroneously distributed as representing *Eugenia vidaliana* Elm.); Tayabas (Quezon) Province, Casiguran, *Bur. Sci. 45439 Ramos* and *Edaño*. BOHOL, *Bur. Sci. 43087 Ramos* (distributed under an unpublished binomial derived from the name of the island). MINDANAO, Agusan Province, Diuata Mountains, *Bur. Sci. 83730 Ramos* and *Convocar*.

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[4] See Merrill, E. D. and L. M. Perry. A synopsis of Acmena DC., a valid genus of the Myrtaceae. Jour. Arnold Arb. 19 (1938) 1–20.

ACMENA De Candolle

ACMENA ACUMINATISSIMA (Blume) Merr. and Perr.

Acmena acuminatissima (Blume) Merr. and Perr., Jour. Arnold Arb. 19 (1938) 12; Amshoff in Backer, Beknopte Fl. Java 4 B I Myrt. (1944) 8.

Myrtus acuminatissima Blume, Bijdr. (1826) 1088.
Syzygium acuminatissimum DC., Prodr. 3 (1828) 361.
Eugenia acuminatissima Kurz, Prel. Rep. Veg. Pegu App. A. 63 (1875) 51; Jour. As. Soc. Bengal 46 2 (1877) 67, et auct, plur., non Miq. (1847), nec Berg (1857–59).
Eugenia cumingiana Vidal, Phan. Cuming. Philip. (1885) 173; Henders. Gard. Bull. Singapore 12 (1949) 260 *fig. 52* and *fig. 5* (p. 9).
Eugenia saligna C. B. Rob., Philip. Jour. Sci. 4C (1909) 392; Merr., Enum. 3 (1923) 176. non *Jambosa saligna* Miq.
Syzygium cumingianum Gibbs, Jour. Linn. Soc. Bot. 42 (1914) 76.
Eugenia attenuatifolia Merr., Philip. Jour. Sci. 18 (1921) 299.
Eugenia eucaudata Elm., in Merr. Enum. 3 (1923) 176, *nom.* in syn.; Elm., Leafl. Philip. Bot. 10 (1939) 3808, *nom.* "is *Eugenia saligna* (Miq.) C. B. Rob."

This is a common and widely distributed species, occurring not only throughout the Philippines, but extending from Tenasserim and the Andaman Islands to southern China (*Eugenia subdecurrens* Merr. and Chun. Sunyat. 2 (1935) 289) through the Malay Peninsula to Sumatra, Java, Borneo, Timor and the Solomon Islands. It is the only representative of the genus known from the Philippines. Henderson, Gard. Bull. Singapore 12 (1949) 260, *figs. 51A, 52,* accepts the name *Eugenia cumingiana* Vidal, which is correct if the species be considered to belong in *Eugenia* Linn. He cites the Koorders and Valeton very excellent figure of *Eugenia acuminatissima* Kurz, Atlas Baumart. Java 3 (1915) *fig. 506,* as representing the species, but for some reason, unaccountable to me, says, "excl. fruit"; and yet the fruit as depicted by them illustrates one of the striking characters of the genus *Acmena,* which holds for all of the fruits of the species that I have examined, i.e., the peculiarly ruminate character which Henderson describes, as did Koorders and Valeton. In his own, *fig. 51A,* he did not show this striking character, probably for the reason that he had depicted it in the germinating seed, *fig. 5b,* p. 9. If any group is worthy of segregation from *Eugenia* Linn., *sensu lat.,* as a genus, I am of the opinion that the ruminate seed characters plus the anthers opening by terminal slits, which Henderson does show, make this group one well worthy of recognition. I see no reason for eliminating the fruit in the Koorders and Valeton illustration.

CLEISTOCALYX Blume[a]

The one character by which this genus is very easily distinguished is that, as in the large American genus *Calyptranthes* Swartz (1788), there is no evidence of free sepals, that part of the calyx above the tube being entirely fused into a circumscissile calyptra, which falls as a whole; in the material that I have examined the fusion is so complete that there is no evidence of calyx segments, quite as in *Calyptranthes* Swartz. It seems to me that it would be just as logical to reduce the large American genus *Calyptranthes* Swartz to one of its allied genera, which no systematist, as far as I am aware, has ever even suggested, as it would be to reduce *Cleistocalyx* Blume to *Eugenia* Linn. as Bentham and Hooker f. and Niedenzu did, and which Henderson accepted, Gard. Bull. Singapore **12** (1949) 264, although the latter did recognize *Cleistocalyx* Blume a section of *Eugenia* Linn. coordinate with *Syzygium* Gaertner, *Acmena* DC. and with his own sectional segregate *Fissicalyx* Henders.

As a matter of fact Blanco in 1837 and in 1845, in considering one of the Philippine species of *Cleistocalyx,* placed it in *Calyptranthes* Swartz, as did Hance in 1851–52, when he described *Calyptranthes mangiferifolia* Hance [*Cleistocalyx operculatus* (Roxb.) Merr. and Perr.] from Macao specimens, thinking that what he had was a plant introduced by the Portuguese from tropical America.

Sometimes, perhaps, "the wish is the father of the thought" among those who may object to the subdivision of large and cumbersome genera, those who advocate this procedure, and those who accept various subdivisions of *Eugenia* Linn. and have even further subdivided *Syzygium* Gaertn. Thus Guillaumin in his treatment of the Myrtaceae of New Caledonia, Bull. Soc. Bot. France **85** (1938) 652, objects to our reduction of *Acicalyptus* A. Gray to *Cleistocalyx* Blume, assuming that we misinterpreted Blume's genus because in his description Blume definitely stated, regarding the calyx, "limbo supero, primum clauso, sub anthesi in lobos 4 v. 5 irregulares longitudinaliter fisso, deciduo." But neither Blume's actual specimens nor his *fig. 56* show such characters, but rather a strictly entire circumscissile deciduous calyptra, as do all of the other species we have placed in *Cleistocalyx*. It is suspected that the "lobos 4 v. 5 irregulares" etc. was added by Blume to accommodate *Cleistocalyx nervosus* Blume (*Eugenia nervosa* Lour.) which Blume knew only from the published description, which he misinterpreted, and which is a true *Syzygium* (*S. oblatum* Wall.; *Eugenia oblata* Roxb.) Morphologically the only difference that we can detect as between *Acicalyptus* A. Gray and *Cleistocalyx* Blume, is the more ligneous and elongated calyptras of the former as compared with the usually thinner and sometimes merely hemispheric ones of the latter. We interpret Blume's genus from the actual specimens on which the description was based, the "lobos 4 v. 5 irregulares longitudinaliter fisso" being nonexistent.

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[a] See Merrill, E. D. and L. M. Perry. Reinstatement and revision of Cleistocalyx Blume (Including Acicalyptus A. Gray), a valid genus of the Myrtaceae. Jour. Arnold Arb. **18** (1937) 322–348, *pl. 215.*

CLEISTOCALYX ARCUATINERVIUS (Merr.) Merr. and Perr.

Cleistocalyx arcuatinervius (Merr.) Merr. and Perr., Jour. Arnold Arb. 18 (1937) 333, *pl. 215, figs. 16–18.*

Eugenia arcuatinervia Merr., Philip. Jour. Sci. 1 Suppl. (1906) 104, Enum. 3 (1923) 158.

Eugenia sibulanensis Elm., Leafl. Philip. Bot. 10 (1939) 3808, *nom.*, "is *Eugenia arcuatinervia* Merr."

A species widely distributed in the Philippine forests, extending from northern Luzon to Mindanao. Some older but not previously cited collections and some recent ones are *Cuming 1275, 1325,* from Cagayan Province, Luzon, *Cuming 1710* from Samar, and *P. N. H. 8373 Sulit* from Laguna Province, Luzon.

CLEISTOCALYX OPERCULATUS (Roxb.) Merr. and Perr.

Cleistocalyx operculatus (Roxb.) Merr. and Perr., Jour. Arnold Arb. 18 (1937) 337, *pl. 215, figs. 41–48, cum. syn.*

Eugenia operculata Roxb., Hort. Beng. (1814) 87, *nomen nudum,* Fl. Ind. ed. 2 2 (1832) 386; descr. Henders. Gard. Bull. Singapore 12 (1949) 265, *fig. 58, cum. syn.*

Syzygium nervosum DC., Prodr. 3 (1828) 260; Mém. Myrt. 42 (1842) *pl. 16,* non *Cleistocalyx nervosus* Blume.

Eugenia clausa C. B. Rob., Philip. Jour. Sci. 4C (1909) 380; Merr., Enum. 3 (1923) 162, *cum. syn.*

This is a common and widely distributed species in the Philippines, and outside of the Archipelago is recorded from Burma to southeasthern China and Hainan (*Eugenia divaricatocymosa* Hay.; *Calyptranthes mangiferifolia* Hance), Indo-China, the Malay Peninsula, Sumatra, Java, Borneo, extending as far to the southeast as tropical Australia. Additional synonyms are *Calyptranthes makal* sensu Blanco (1837), non Raeusch., *C. Syzygium* sensu Blanco (1845), non Sw., *Syzygium nodosum* and *S. angkolanum* Miq. (1855), *Eugenia holtzei* F. Muell. (1886), *Syzygium operculatum* Niedenz. (1893), *Eugenia holtzeana* F. Muell. (1899), and *Eugenia holteana* F. Muell. (1917).

Blume's description of the genus *Cleistocalyx* was based on an actual specimen, the type being *Cleistocalyx nitidus* Blume (*Jambosa nitida* Korth.) from Borneo. His other binomial, *C. nervosus* Blume, was published under a misapprehension, its basis being wholly the description of *Eugenia nervosa* Lour. Fl. Cochinch. (1790) 308, of which *Myrtus loureiri* Spreng. (1825) is an exact synonym. Out of curiosity I again checked Loureiro's description. It is definitely that of a *Syzygium* and it certainly applies to *Syzygium oblatum* Wall. (*Eugenia oblata* Roxb.). It should be noted that Loureiro's specific name was taken from the fruit, not from the leaf characters, for he indicates the fruit as "globosa, 1–pollicaria, nervosa," while Gagnepain in 1920 described it as "15–18 mm. de diam., strié en long," and Henderson in 1949 as 1.75 x 2 cm. "faintly vertically ridged." Loureiro's other characters apply sufficiently well. No other known Indo-China species conforms with Loureiro's description, and in *Eugenia* the binomial *E. nervosum* Lour. is valid and replaces *Eugenia oblata* Roxb., (1814, *nom.*, 1832, *descr.*). In *Syzygium* the specific name is invalidated by the totally different *S. nervosum* DC. (1828) which is a synonym of *Cleistocalyx operculatus* (Roxb.) Merr. and Perr. The somewhat earlier *Myrtus loureiri* Spreng. (1825) is not available as its publication was illegitimate.

Syzygium nervosum DC., Prodr. 3 (1828) 260, is in a different category, for it was a new name for *Eugenia operculata* Roxb. "Cat. Calc. p. 37 (v. s.)" and his descriptive data, with the significant phrase "calycibus integerrimis" was based on a duplicate he had received from Calcutta, and doubtless from Roxburgh himself. Apparently he proposed the new binomial because he realized that the specific name Roxburgh had selected, although it applied beautifully to the species, did not apply to *Syzygium* as De Candolle himself delimited it; and yet in his brief species description he did inadequately indicate its striking calyx character. However, this discussion is beside the point, for as shown above the specific name *nervosum* was published in *Cleistocalyx* through a misconception, and although De Candolle did publish the first description of the species here considered, the beautifully descriptive name selected by Roxburgh and first appearing in 1814 as a *nomen nudum*, but not actually described by Roxburgh until 1832, stands, both in *Eugenia* and in *Cleistocalyx;* in *Syzygium*, however, the specific name *nervosum* has priority over *operculatum*.

CLEISTOCALYX PAUCIPUNCTATUS Merr. and Perr.

Cleistocalyx paucipunctatus Merr. and Perr., Jour. Arnold Arb. 18 (1937) 336, *pl. 215, figs. 22–23*

Eugenia paucipunctata Merr., Philip. Jour. Sci. 10C (1915) 215, Enum. 3 (1923) 173, non Koord. and Val. (1899).

This species is still known only from the type collection, Luzon, Benguet Province, *Merrill Philip. Pl. 1709*, erroneously distributed as representing the distinctly different *Eugenia calcicola* Merr. The specific name originally selected by me is invalid in *Eugenia*, but in our consideration of the species under *Cleistocalyx* we deliberately published *Cleistocalyx paucipunctatus* Merr. and Perr. as a new name, not as a new combination; hence the absence of parenthetic citation in the entry above. A new specific name will be needed only by those who prefer to retain this species in *Eugenia* Linn. In its general appearance this species is remarkably similar to *Eugenia abbreviata* Elm. = *Syzygium abbreviatum* (Elm.) Merr., but the latter is a true *Syzygium*, lacking the characteristic calyx operculum of *Cleistocalyx* Blume.

SYZYGIUM Gaertner

In this paper I have interpreted *Syzygium* Gaertner to include *Jambosa* De Candolle, as did Dr. Perry[6] and myself in our 1939 consideration of the numerous Bornean representatives of the group (156), and as we did in other papers appertaining to the species of Indo-China (51 species), China (50 species), New Guinea (about 150 species), and Fiji (18 species).[7] More recently Dr. Amshoff[8] has considered the 50 species known from Java, which for the most part had been retained in

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[6] Merrill, E. D. and L. M. Perry. The Myrtaceous genus Syzygium Gaertner in Borneo. Am. Acad. Arts Sci. Mem. 18 (1939) 135–202 (Mem. Gray Herb. 4 135–202).

[7] Merrill, E. D. and L. M. Perry. The Indo-Chinese species of Syzygium Gaertner. Jour. Arnold Arb. 19 (1938) 99–116.

——— The Myrtaceae of China. Op. cit. 19 (1938) 191–247.

——— Plantae Papuanae Archboldianae, IX. Op. cit. 23 (1942) 233–297.

——— Myrtaceae in Smith, A. C. Fijian plant studies, II. Sargentia 1 (1942) 74–79.

[8] Amshoff, G. J. Myrtaceae, in Backer, C. A. Beknopte Flora van Java Alf. IVB(I): Myrt. (1944) 1–39, Blumea 5 (1946) 495–507.

Eugenia by earlier authors. She recognized the segregated genera *Acmena* De Candolle and *Cleistocalyx* Blume, and restricted *Eugenia* Linn. to a single species, the introduced *Eugenia uniflora* Linn.[9] As noted above, Guillaumin, for the New Caledonian species of this complex recognized *Eugenia* Linn. (apparently all species belonging in *Jossinia* Commerson), *Jambosa* De Candolle, *Syzygium* Gaertner, and *Acicalyptus* A. Gray (which we believe cannot be distinguished from *Cleistocalyx* Blume), and further retained *Caryophyllus* Linn. as generally distinct from *Syzygium* Gaertn. Clearly the modern trend is to a reasonable division of that vast aggregate retained by most authors under a single generic designation, *Eugenia* Linnaeus.

Airy Shaw,[10] while accepting *Syzygium* Gaertner as generically distinct from *Eugenia* Linnaeus, voices his objection to the segregation of such small groups as *Acmena* De Candolle and *Cleistocalyx* Blume from Gaertner's genus, preferring to retain *Syzygium* Gaertner, *sensu latissimo,* to take most of the Old World species of this complex. In further amplifying the characters of *Syzygium* Gaertner by the reduction of *Aphanomyrtus* Miq. (*Pseudoeugenia* Scortechini) and *Tetraeugenia* Merrill, he states:

> "I am convinced, however, that there is no justification for maintaining either *Tetraeugenia* Merr. or *Aphanomyrtus* Miq. (*Pseudoeugenia* Scort.) distinct from *Syzygium* Gaertner, of which they surely represent merely the extreme stages in floral reduction. In vegetative characters there is nothing to distinguish them from *Syzygium;* they totally lack any *facies* of their own. For the same reason I believe that *Acmena* DC. and *Cleistocalyx* Bl. should not be separated from the larger genus; both contain forms intimately linked with various species of *Syzygium.* With better reason could Miquel's section *Leptomyrtus* be raised to generic rank for the rather distinct group of *Syzygium* with conspicuous bracteoles and glaucous angled calyx-tubes."

As opposed to those who would still further subdivide *Syzygium* Gaertner, such as Guillaumin, and those who would amplify its characters by the reduction of the genera above mentioned, there are, of course, those who cannot bring themselves to subdivide the protean *Eugenia*, and who continue to use that generic designation *sensu latissimo*. Henderson's [11] recent excellent consideration of the species of the Malay Peninsula represents the views of the ultra-conservatives. His estimate of the number of distinct species as "about 1,000" is more than conservative. I suspect from my own studies that merely the *Syzygium* complex as it is developed in the Old World tropics may already exceed that number, and the number of true *Eugenia* species in tropical America is legion.

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[9] *Syzygium amshoffianum* nom. nov.

Eugenia dolicophylla Koord. and Val., Meded. Lands Plantent. 40 (1909) 78. (Bijdr. Boomsoort. Java 6:78) "doligophylla," Atlas Baumart; Java 3 (1915) *pl. 462*, non Kiaersk. (1893).

Syzygium dolichophyllum Amshoff, in Backer, Beknopte Fl. Java IVB (I): Myrt. (1944) 28, non Merr. and Perr. (1942).

A species known only from Java. The currently used specific name is invalid in both *Eugenia* and *Syzygium*. *Syzygium dolichophyllum* Merr. and Perr. is a New Guinea species based on *Jambosa dolichophylla* Lauterb and K. Sch.

[10] Airy Shaw, H. K. Additions to the flora of Borneo and other Malay Islands. Kew Bull. (1949) 117–125.

The arguments for a limited number of segregated genera have been well stated by their proponents. Those who are in favor of retaining all species of both hemispheres in one manifestly collective genus, *Eugenia* Linn., *sensu latissimo,* and those who favor the segregation of most of the Old World species under *Syzygium* as a collective genus for the very numerous Old World species, have stated their case. In a third category are those, among whom I am one, who recognize *Syzygium* for most of the Old World species, but who advocate the segregation of certain small and reasonably distinct (or in some cases very distinct) groups as worthy of generic status. There is no unanimity of opinion as to what constitutes a genus or as to the limits of this or that group, nor is there likely to be until such time as some able and courageous individual with ample time and access to comprehensive collections of study material may be inspired to challenge the generic limits for both the New World and the Old World forms. I have an idea from my limited knowledge of the New World species, that there may ultimately be as many, or more, genera segregated from the New World complex as have been proposed for the Old World *Syzygium* complex.

The claim that *Eugenia* should not be subdivided merits some attention, although those who accept this concept are frankly following the lines of least resistance. To accept *Syzygium* Gaertner as all-inclusive for the Old World species of *Eugenia,* denying the validity of such proposed segregates as *Cleistocalyx, Acmena, Jossinia, Aphanomyrtus* (*Pseudoeugenia*), and perhaps even *Jambosa* and *Caryophyllus,* and other groups which have been characterized by this or that author, impresses me as somewhat illogical. It is evident that with complete material, most or all of these segregated groups are more easily and definitely separable from *Syzygium*, than is *Syzygium* separated from *Eugenia* proper. If one cannot subdivide *Syzygium* on the basis of evident and reasonably constant characters, why attempt to distinguish *Syzygium* from *Eugenia*, and why not return to the Bentham-Hooker f. concept?

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[11] Henderson, M. R. The genus Eugenia (Myrtaceae) in Malaya. Gard. Bull. Singapore 12 (1949) 1–293, *figs. 1–54.*

In accepting the name *Syzygium* Gaertn. (1788) in preference to *Caryophyllus* Linn. (1754), assuming the two groups to be congeneric, we believe that our procedure in 1939 was legitimate, in spite of the mild criticism inferred by Henderson's statement (probably a reflection of Furtado's opinion) that we complicated the situation by accepting *Syzygium* Gaertn. in place of the earlier *Caryophyllus* Linn., recommending at the same time that Gaertner's name be officially conserved against the Linnaean one. He states: "But the practice of using a later name in the hope that at some future date it may be conserved against an older valid name seems a somewhat dubious procedure." I still believe that our point was well taken, in that up to 1939 only 22 binomials had been published under *Caryophyllus*, and that there had been no transfers to it since 1874 except one in 1905, as against 300 published binomials in *Syzygium*. The numbers now stand as of 1950 at 33 for *Caryophyllus* and over 700 for *Syzygium*, to which may be added about 160 new binomials in the latter genus appearing in this paper. In this particular case there are those who prefer to retain *Caryophyllus* Linn. as generically distinct from *Syzygium* Gaertn. I am of the opinion that all of the species recognized by Henderson for the Malay Peninsula, outside of the very few in his sections *Acmena, Cleistocalyx,* and perhaps *Fissicalyx*, belong in *Syzygium*, and if these be transferred, about 90 additional new binomials will be involved in the latter genus.[12]

In 1915 I called attention to the fact that there was nothing in the modern concept of the rubiaceous genus *Nauclea* Linn. that conformed to the original Linnaean concept and definition.[13] Hasskarl had observed this in 1839, and then actually redefined *Nauclea* with himself as its authority, leaving out of consideration the Linnaean concept entirely. This procedure was, of course, not in conformity with any accepted rules of nomenclature. Yet clearly in this case *Nauclea* Hassk. (1839) should have been recommended for conservation against *Nauclea* Linn. (1762), and the Linnean designation thus disposed of *Sarcocephalus* Afzel. (1818) in its currently accepted sense would have been available to take the Linnaean *Nauclea* species. Unfortunately, as I now see it, I adhered strictly to the letter of the law, proposed *Neonauclea* Merr. to take the species of *Nauclea* Hassk., non Linn. and most other modern authors, reinstated *Nauclea* Linn. to replace *Sarcocephalus* Afzel., transferring 46 *Nauclea* names to *Neonauclea* Merr. and 20 *Sarcocephalus* names to *Nauclea* Linn. There will always be constant confusion as between *Nauclea* Hassk., non Linn. *Neonauclea* Merr., and *Nauclea* Linn., non Hassk. (*Sarcocephalus* Afzel.); and yet unless official conservation intervenes, the generic names must, or at least should, be applied as I then indicated. I have been tempted at times to initiate action for conservation of *Nauclea* Hassk., non Linn. and *Sarcocephalus* Afzel. (*Nauclea* Linn.). In fact, I have urged some of my correspondents that such action should be taken merely as a matter of convenience.

As to the Philippine species of this *Syzygium-Eugenia* complex, the first intensive study of the group by Dr. C. B. Robinson in 1909, resulted in his recognizing 98 species. The percentage of endemism was very high. As the collections of reference material increased it became evident that the genus contained a great many more species than was indicated in 1909. By 1923 when my Enumeration of Philippine Flowering Plants was published, the number of species had been increased to 182, and since that time a few additional species have been described. In these early studies *Eugenia* Linn. was interpreted

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[22] *Syzygium hendersonii* nom. nov.
Eugenia auriculata Ridl., Jour. Str. Branch Roy. As. Soc. 61 (1912) 7; Henders. Gard. Bull Singapore 12 (1949) 54, *fig. 6a*, non *Syzygium auriculatum* Brongn. and Gris (1865). Malay Peninsula, Dindings at Lumut.
Syzigium urophyllum nom. nov.
Eugenia caudata King, Jour. As. Soc. Beng. 702 (1901) 105. (Mater. Fl. Malay. Penin. 3: 105); Henders. Gard. Bull. Singapore 12 (1949) 148, *fig. 29, c-d*, non *Syzygium caudatum* Airy Shaw (1949).
¿*Myrtus caudata* Wall. List. no. 3631, (1831), *nom. nud.*

In reducing *Tetraeugenia* Merr. and *Aphanomyrtus* Miq. (*Pseudoeugenia* Scort.) to *Syzygium* Gaertn., thereby further broadening the limits of the latter genus, Airy Shaw, Kew Bull. (1949) 122, also transferred *Tetraeugenia caudata* Merr. to *Syzygium*. Henderson, l. c., who saw the Calcutta specimen of *Wallich 3631*, which was from Singapore, expressed doubt if it is a *Eugenia* (*Syzygium*). While King's specific name is valid in *Eugenia*, it cannot be used in *Syzygium*. The species is rather widely distributed in the Malay Peninsula, and may occur in southern Siam.

[23] Merrill, E. D. On the application of the generic name *Nauclea* of Linnaeus. Jour. Washington Acad. Sci. 5 (1915) 539–542.

in Bentham-Hooker f. sense, following the lead of most modern authors who had studied the Old World species.

In the present study, which is frankly nomenclatural, an attempt is made to bring the technical names of the Philippine species into conformity with my present concept of reasonable generic limits for the entire group. Two species of *Eugenia* have been combined and accounted for as a single species of *Xanthomyrtus* Diels. Three species are placed under *Cleistocalyx* Blume, one under *Acmena* DC., eight under *Jossinia* Commerson, and *Eugenia* Linn. is now restricted to a single introduced species of American origin, this being *Eugenia uniflora* Linn. the actual type of the Linnaean genus, which up to 1923 had not been recorded as Philippine. Sixteen species, accepted as valid in 1923 have been reduced to synonymy. On the basis of the material available to me in the course of this study, including duplicates distributed from Manila before 1940 and determined to the genus only, and recently collected material sent to me for identification by Dr. Quisumbing, nineteen species are described as new. In spite of reductions of sixteen of the species recognized in 1923, and the transfer of certain *Eugenia* species to other generic groups, the total number of Philippine *Syzygium* species now stands at 187, slightly more than in 1923, with thirteen in segregated genera, or a total of 200. This is not the entire story. There are perhaps ten distinct species represented by inadequate specimens in the collections available to me which should not be characterized until better specimens become available. None of them can be matched in the very extensive collection of Malaysian-Philippine-Papuasian-Polynesian material available to me.

One is constantly surprised at the high percentage of endemism that characterizes this genus, whether one deals with the species of China, Indo-China, the Malay Peninsula, Sumatra, Borneo, Java, the Philippines, Celebes, Fiji, or New Guinea. The specific endemism as of the present time for the entire complex, as to the Philippine species, is 81 per cent. A very serious attempt has been made to match the numerous Philippine species with those from neighboring islands of Malaysia and Papuasia, but with very little success; a few Philippine species have been reduced to Bornean forms, and a few have appeared in collections from the islands immediately south of the Philippines. This was to be expected in view of what is now known regarding the phytogeography of Philippine plant species. Again one is impressed by the fact that a very considerable number of species (70) are still known only from the collections on which the original descriptions were based, a reflection of remarkably developed local endemism, and inadequate botanical exploration. It is a rather extraordinary fact that three species are still known only from the specimens collected by Hugh Cuming in various parts of the Philippines between 1836 and 1840, in spite of the vast amount of field work that has been prosecuted in the islands within the past century; and if these specimens are correctly localized, as I think they are, one of them came from mountains plainly visible from Manila.

It is a well-known fact that a very high percentage of all species in those Malaysian genera, all families, that are characteristic of the primary forests are of strictly limited geographic distribution; and essentially *Syzygium* and its allied genera are primary forest types. Instead of the endemism percentage being reduced as large collections become available from this or that region, such as Java, Celebes, New Guinea, Borneo, Sumatra, the Philippines, the Malay Peninsula, it tends to remain fairly constant as comparative studies are made. The fact that as modern collections come in from what was considered to be fairly well explored areas, new species constantly appear, merely indicates how little really intensive botanical exploration has been done in Malaysia as a whole (including the Philippines and New Guinea), as compared with such better known areas as Europe, and most of North America north of Mexico. There are those who seem to be disconcerted by the number of new species that are constantly being described from this or that area, particularly from the previously unexplored, or only most sketchily explored parts of the Malay Archipelago; and yet it is manifest that many thousands of new species will be named and characterized in future years as available collections are intensively studied and as new material becomes available.

Constantly under suspicion as being species not confined to the Philippines are those species of uniformly wide distribution within the archipelago. There are certain "wides" both as to their Philippine and extra-Philippine ranges, such as *Cleistocalyx operculatus* (Roxb.) Merr. and Perr., *Acmena acuminatissima* (Blume) Merr. and Perr., *Syzygium claviflorum* (Roxb.) Cowan and Cowan, *S. fastigiatum* (Blume) Merr. and Perr., *S. leucoxylum* Korth., *S. longiflorum* Presl, *S. oleinum* Wall., and *S. polyanthum* (Wight) Wall.; all of these are of natural distribution, as opposed to such man-distributed species (because of their edible fruits) as *Syzygium aequum* (Burm. f.) Alston, *S. cumini* (Linn.) Skeels, *S. jambos* (Linn.) Alston, *S. malaccense* (Linn.) Merr. and Perr., and *S. samarangense* (Blume) Merr. and Perr. The last five species were manifestly introduced into the Philippines from Malaya before the islands were colonized by the Spaniards in the sixteenth century.

Among the widely distributed Philippine endemics, that is, species for the most part occurring in all of the larger islands (and many of the smaller ones), from northern Luzon to Mindanao, are *Syzygium astronioides* (C. B. Rob.) Merr., *S. bataanense* (Merr.) Merr., *S. calubcob* (C. B. Rob.) Merr., *S. clavellatum* (Merr.) Merr., *S. everettii* (C. B. Rob.) Merr., *C. luzonense* (Merr.) Merr., *S. mananquil* (Blanco) Merr., *S. mimicum* (Merr.) Merr., *S. pallidum* (Merr.) Merr., *S. phanerophlebium* (C. B. Rob.) Merr., *S. tripinatum* (Blanco) Merr., and *S. xanthophyllum* (C. B. Rob.) Merr. There is every reason to expect that some of these widely distributed Philippine species will eventually appear in collections made from insular areas to the south, southwest and southeast of the Philippines. So far, however, comparatively few of the species of this group described from Philippine material, such as *Jossinia aherniana* (C. B. Rob.) Merr., *Syzygium everettii* (C. B. Rob.) Merr., and *S. panduriforme* (Elm.) Merr. have appeared in collections made in the islands immediately south of Mindanao and between that island and Celebes; and a somewhat larger number now have the known distribution Philippines-Borneo. Most of the species having this range occur in the Philippines chiefly in the Sulu Archipelago and in Palawan, which as manifestly a natural range. Doubtless as intensive studies are made on the basis of ample collections, these lists will be somewhat increased, but I suspect that the total number of Borneo-Philippine, and Talaud-Philippine species (or even Celebes-Philippine) will never become very large.

SYZYGIUM ABBREVIATUM nom. nov.

Eugenia abbreviata Elm., Leafl. Philip. Bot. 8 (1915) 2776; Merr., Enum. 3 (1923) 156, non Urban, 1909.

The type is *Elmer 14263* from Benguet Province, Luzon, two specimens of which are before me. Two additional collections are *Loher 2489* (Herb. Kew.) and *Loher 2498* (U. S. National Herbarium, perhaps an error from *2489*) from the same province. In facies this species very closely approximates *Eugenia paucipunctata* Merr. = *Cleistocalyx paucipunctatus* (Merr.) Merr. and Perr., also from Benguet and still known only from the type collection. However, the Elmer species is unquestionably a *Syzygium*, not a *Cleistocalyx*, although in the specimens I have seen most of the floral parts have fallen; the calyx margin is distinctly toothed, conforming to Elmer's description. In vegetative characters the species may be easily distinguished from *Cleistocalyx paucipunctatus* (Merr.) Merr. and Perr. by the distant and distinctly impressed primary nerves on the upper surfaces of the leaves. I deliberately propose *Syzygium abbreviatum* Merr. as a new name, not a new combination.

SYZYGIUM ABULUGENSE nom. nov.

Eugenia propinqua Merr., Philip. Jour. Sci. 7C (1912) 315, Enum. 3 (1923) 174, non *Syzygium propinquam* Vieill. ex Guillaumin (1938), in syn.

A species known only from the type collection, *Bur. Sci. 13911 Ramos,* from the Abulug River, Cagayan Province, Luzon.

SYZYGIUM ACROPHILUM (C. B. Rob.) comb. nov.

Eugenia acrophila C. B. Rob., Philip. Jour. Sci. 4C (1909) 389; Merr., Enum. 3 (1923) 156.

This species was based on four collections from Mount Pulog and Mount Tapulao, in Buenguet and Zambales provinces, Luzon. An additional recent collection from Mount Pulog is *P. N. H. 4327 Celestino.*

SYZYGIUM AFFINE sp. nov.

Species *S. striatulo* manifeste affinis, differt nervis primariis inter se magis (6–10 mm.) distantibus, minus adscendentibus, floribus minoribus. Ut videtur arbor parva, glabra, ramis pallidis vel pallide brunneis, teretibus, ramulis ultimis circiter 1 mm. diametro, plerumque sulcatis vel plus minusve 4-angulatis; follis ellipticis vel oblongo-ellipticis, subcoriaceis, vel coriaceis, 6–10 cm. longis, 3–5 cm. latis, sicco plerumque brunneis vel pallide brunneis, vel supra subolivaceis, opacis, breviter obtuse acuminatis, basi acutis; nervis primariis utrinque plerumque 10–12, inter se 6–10 mm. distantibus, in venam submarginalem circiter 2 mm. a margine confluentibus, subpatulis, leviter adscendentibus, subtus distinctis, elevatis, nervis secundariis reticulisque sublaxis minus distinctis, omnibus subelevatis; petiolo 4–10 mm. longo; inflorescentiis terminalibus, 5–10 cm. longis, 8–10 cm. latis, plerumque e basi ramosis, ramis primariis patulis vel subpatulis, 3–4 cm. longis, floribus in ramulis ultimis in triadibus dispositis, bracteis inferioribus linearis, 5–6 mm. longis, superioribus lineari-lanceolatis, acuminatis, brevioribus, caducis, bracteolis minutis, obscuris, deciduis; flori-

bus inter minores, sessilibus, in triadibus dispositis, calycibus circiter 6 mm. longis, deorsum angustatis, pseudostipitatis, margine crenatis in floribus vetustioribus subtruncatis, ore sub anthesin 3 mm. diametro; petalis calyptratim deciduis; filamentis numerosis, stylo 6–8 mm. longo.

LUZON, Nueva Ecija Province, *For. Bur. 22171 Alvarez* (U. S. Nat. Herb., Brit. Mus., Kew); Bulacan Province, Angat, *Bur. Sci. 22295 Ramos,* (type, herb. Arnold Arboretum, dupl. U. S. Nat. Herb., and Kew, *Merrill Philip. Pl. 1934,* distributed as *E. macgregorii* Merr., Rizal Province, Bosoboso, *Loher 2487,* (Kew), *Vidal 1416* (Kew); Quezon Province, Guinayangan, *Bur. Sci. 20820 Escritor* (Kew, U. S. Nat. Herb.); Sorsogon Province, *Elmer 17274,* erroneously distributed as *Eugenia philippinensis* C. B. Rob.

In making the preliminary identifications of all of the cited and mostly previously unidentified specimens, I at first placed them with *Eugenia macgregorii* Merr., from which they differ in the characters mentioned in contrasting the species with *Syzygium striatulum* (C. B. Rob.) Merr., another allied form.

SYZYGIUM ALBAYENSE sp. nov.

Arbor glaberrima, ramis ramulisque stricte teretibus, ultimis 3–4 mm. diametro; foliis oppositis, petiolatis (petiolo 5–10 mm. longo), coriaceis, sicco supra castaneis vel atro-castaneis, subtus paullo pallidioribus, utrinque nitidis, ellipticis vel oblongo-ellipticis, 12–18 cm. longis, 4–8 cm. latis, obscure puncticulatis, basi acutis vel late acutis, apice breviter (ca. 1 cm.) acuminatis; nervis primariis utrinque circiter 15, subtus distinctis, distantibus, leviter curvatis, in venam submarginalem 1.5–2.5 mm. a margine confluentibus, reticulis primariis laxis, obscuris; inflorescentiis terminalibus, paniculatis, circiter 15 cm. longis, e basi ramosis, ramis primariis inferioribus 10 cm. longis superioribus brevioribus, rhachidibus teretibus, ramulis ultimis obscure angulatis; floribus binis vel trinis, sessilibus, in ramulis ultimis dispositis, bracteolis paribus binis decussatis subtensis, his late ovatis, rotundatis, coriaceis, 2–3 mm. longis; floribus 4-meris, 1.2–1.5 cm. diametro, calycis tubo sub anthesin fere patelliformibus 8–10 mm. diametro, coriaceis, lobis subreniformibus, latissime rotundatis, 1.5 mm. longis et 3 mm. latis; petalis orbiculari-ovatis, late rotundatis, 5-5.5 m. longis, concavis, primo imbricatis, liberis sed vix patulis, partibus medianis perspicue consperse glandulosis; staminibus multiseriatis, filamentis ad 6 mm. longis; stylo 7 mm. longo sursum angustato.

LUZON, Albay Province, *Cuming 913,* Herb. Kew. (type) and Brit. Mus.

In spite of its distinctly petioled leaves which are acute, not cordate, at the base, and its strictly terete branches and branchlets, this species is clearly allied to *Syzygium intumescens* (C. B. Rob.) Merr. The group is a natural one, consisting of a few species, characterized by the sessile flowers which terminate the ultimate branchlets being subtended by two pairs of decussate coriaceous bracteoles.

SYZYGIUM ALCINAE (Merr.) Merr. and Perr.

Syzygium alcinae (Merr.) Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 190, (Mem. Gray Herb. 4:190).
Eugenia alcinæ Merr., Philip. Jour. Sci. 10C (1915) 216, Enum. 3 (1923) 157.

Southern Luzon, Culion, Palawan, Panay; also in British North Borneo. Various collections including *Merrill 9224, 9316.*

SYZYGIUM ALVAREZII (C. B. Rob.) comb. nov.

Eugenia alvarezii C. B. Rob., Philip. Jour. Sci. 4C (1909) 390, *excl. 18379 Alvarez;* Merr., Enum. 4 (1923) 157.
Eugenia maquilingensis Elm., Leafl. Philip. Bot. 8 (1919) 3096.

Widely distributed at higher altitudes, northern Luzon to Mindoro and Panay. It may prove to be but a high altitude form of *Syzygium nitidum* Benth., to which it is closely allied. On the other hand there may be those who would retain *Eugenia maquilingensis* Elm. as a distinct species. The actual type is *F. B. 18353 Alvarez.* Recent very typical collections are *P. N. H. 4340 Celestino, 7684, 7780 Sulit* from Mount Pulog and Mount Nañgaoto, Mountain Province, Luzon.

SYSYGIUM ANGULARE (Elm.) comb. nov.

Eugenia angularis Elm., Leafl. Philip. Bot. 4 (1912) 1434; Merr., Enum. 3 (1923) 157.

A species still known only from the original collection from Sibuyan, *Elmer 12080.*

SYZYGIUM ANGULATUM (C. B. Rob.) comb. nov.

Eugenia angulata C. B. Rob., Philip. Jour. Sci. 4C (1909) 354; Merr., Enum. 3 (1923) 157.

A species still known only from the two Mindanao collections cited in the original description, *Williams 2164, Clemens s. n.*

SYZYGIUM ANTONIANUM (Elm.) comb. nov.

Eugenia antoniana Elm., Leafl. Philip. Bot. 4 (1912) 1425; Merr., Enum. 3 (1923) 157.

A species still known only from the original collection, *Elmer 11621*, from Mount Apo, Davao, Mindanao.

SYZYGIUM APOENSE (Elm.) comb. nov.

Eugenia apoensis Elm., Leafl. Philip. Bot. 4 (1912) 1901; Merr., Enum. 3 (1923) 157.

Still known only from its original collection, *Elmer 11594* from Mount Apo, Davao, Mindanao.

SYZYGIUM AQUEUM (Burm. f.) Alst.

Syzygium aqueum (Burm. f.) Alst., Ann. Bot. Gard. Peradeniya 11 (1929) 204.
Eugenia aquea Burm. f., Fl. Ind. (1768) 114; Merr., Enum. 3 (1923) 157, *cum. syn.*
Eugenia mindanaensis C. B. Rob., Philip. Jour. Sci. 4C (1909) 363.

Widely distributed in the Malay Archipelago, as it is in the central and southern Philippines. This is one of the species that manifestly owes its present wide distribution to the activities of man who has disseminated it in cultivation because of its edible fruits. It is certainly an introduced species in the Philippines.

SYZYGIUM ASTRONIOIDES (C. B. Rob.) comb. nov.

Eugenia astronioides C. B. Rob., Philip. Jour. Sci. 4C (1909) 393; Merr., Enum. 4 (1923) 158.
Eugenia bakeri Elm., Leafl. Philip. Bot. 7 (1914) 2355.

A species extending from northern Luzon to Mindanao represented by numerous collections, including *Elmer 14031, 16212, 15375, Merrill Philip. Pl. 1122,* etc.

SYZYGIUM ATTENUATUM (Miq.) Merr. and Perr.

Syzygium attenuatum (Miq.) Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 185. (Mem. Gray Herb. 4:185).
Jambosa attenuata Miq., Fl. Ind. Bot. 1 1 (1855) 437.
Eugenia penangiana Dutchie in Hook, f., Fl. Brit. Ind. 2 (1878) 486.
Eugenia attenuata Koord. and Val., Meded. Lands Plant. 40 (1909) 121. (Bijdr. Boomsoort. Java 6:121); Henders, Gard. Bull. Singapore 12 (1949) 238, *fig. 45 a-b.*
Eugenia purpuricarpa Elm., Leafl. Philip. Bot. 4 (1912) 1435; Merr., Enum. 3 (1923) 174, *syn. nov.*

Still known as a Philippine species only from *Elmer 12818*, from Palawan. I cannot distinguish Elmer's species from *Syzygium attenuatum* (Miq.) Merr. and Perr. which is common and widely distributed in the Malay Peninsula and Borneo. Miquel's type was from Java. Certain Sumatran collections match it very closely. Airy Shaw, Kew Bull. (1949) 121, suggests that the Philippine *Syzygium clavellatum* (Merr.) Merr., *S. clementis* (C. B. Rob.) Merr., *S. rosenbluthii* (C. B.

Rob.) Merr., and *Eugenia purpuricarpa* Elm., all belonging in this group, may represent but a single species.

SYZYGIUM BALERENSE (C. B. Rob.) comb. nov.

Eugenia balerensis C. B. Rob., Philip. Jour. Sci. 6C (1911) 346, Merr. Enum. 3 (1923) 159.

Eugenia brunnea C. B. Rob., op. cit. 4C (1909) 372, non Niedenzu, 1893.

Known only from the east coast of Luzon, Quezon and Camarines, type from Baler, *Merrill 1088, 1069 bis*, etc.

SYZYGIUM BANKENSE (Hassk.) Merr. and Perr.

Syzygium bankense (Hassk.) Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 160. (Mem. Gray Herb. 4:160).

Microjambosa? bankensis Hassk., Hort. Bogor. Descr. (1858) 276.

Microjambosa besukiensis Hassk. ex Miq., Fl. Ind. Bot. Suppl. 1 (1861) 311, *nom.* in *syn.*

Jambosa buxifolia Miq., Fl. Ind. Bot. 1 1 (1858) 1086.

Eugenia bankensis Backer, Schoolfl. Java (1911) 508.

Eugenia besukiensis Merr., Jour. Straits Branch. Roy. As. Soc. 77 (1917) 226.

MINDORO, still known as a Philippine species only by a single collection, *Bur. Sci. 39440 Ramos.* Borneo, Banka; planted in Java fide Amshoff.

SYZYGIUM BARNESII (Merr.) comb. nov.

Eugenia barnesii Merr., Manila, Govt. Lab. Publ. 17 (1904) 37; C. B. Rob., Philip. Jour. Sci. 4C (1909) 360; Merr., Enum. 3 (1923 159.

Still known only from Bataan Province, Luzon, from the cited collections of *For. Bur. 140 Barnes, 733, 1198, 1236 Borden, 2774 Meyer, 251 Whitford.*

SYZYGIUM BATAANENSE (Merr.) comb. nov.

Jambosa bataanensis Merr., Manila, Govt. Lab. Publ. 17 (1904) 36.

Eugenia bataanensis Merr., Philip. Jour. Sci. 1 Suppl. (1906) 104, Enum. 3 (1923) 159.

Originally described from specimens collected in Bataan Province, Luzon, now represented by many collections from central Luzon to Mindoro, and Mindanao.

SYZYGIUM BENGUETENSE (C. B. Rob.) comb. nov.

Eugenia benguetensis C. B. Rob., Philip. Jour. Sci 4C (1909) 374.

A species known from higher altitudes, Bontoc and Benguet sub-provinces, Luzon. Additional collections are *For. Bur. 30169 Costales* from Benguet, *Sandkuhl 313* and *P. N. H. 7893 Celestino* from Mount Polis, Mountain Province (Ifugao), Luzon.

SYZYGIUM BERNARDOI (Merr.) comb. nov.

Eugenia bernardoi Merr., Philip. Jour. Sci. 18 (1921) 304.

Originally described from *For. Bur. 27074 Bernardo* from Cagayan Province, Luzon. A second collection is *Bur. Sci. 33036 Ramos* from Ilocos Norte Province, and a third is *Bur. Sci. 79464 Edaño* from Cagayan Province.

SYZYGIUM BLANCOI (Merr.) comb. nov.

Eugenia blancoi Merr., Philip. Jour. Sci. 10C (1915) 160.

The basis of this species was *Bur. Sci. 17492, 17623 Ramos* from Samar. Additional collections are *Bur. Sci. 21261, 23770, 33538, Ramos* from Camarines Province, Luzon. In general appearance the specimens very closely approximate *Cleistocalyx arcuatinervius* (Merr.) Merr. and Perr. but the calyx is that of *Syzygium,* not of *Cleistocalyx.*

SYZYGIUM BORDENII (Merr.) comb. nov.

Eugenia bordenii Merr., Manila, Govt. Lab. Publ. 35 (1906) 47, Enum. 3 (1923) 160.

Northern Luzon to Mindanao and Basilan represented by numerous collections, the type from Bataan Province, Luzon.

SYZYGIUM BORNEENSE (Miq.) Miq.

Syzygium borneense (Miq.) Miq., Fl. Ind. Bat. 1 (1855) 453; Merr. and Perr., Mem. Amer. Acad Arts Sci. 18 (1939) 190 (Mem. Gray Herb. 4:190), *cum. syn.*

Eugenia borneensis Miq., Anal. Bot. Ind. 1 (1850) 24, *pl. 7.*

Eugenia microcalyx Duthie, in Hook. f. Fl. Brit. Ind. 2 (1878) 493; Henders. Gard. Bull. Singapore 12 (1949) 202.

Eugenia ixoroides Elm., Leafl. Philip. Bot. 4 (1912) 1426; Merr., Enum. 3 (1923) 167.

Elmer 13165 is the type of *Eugenia ixoroides* Elm. which I now, without hesitation, reduce to Miquel's species. Henderson in 1949 most conservatively retained *Eugenia microcalyx* Duthie as the proper name for the species as he understood it, although when we (Merrill and Perry) reduced Duthie's species in 1939, this was on the basis of a critical examination of Miquel's type, which Henderson unfortunately did not see. Miquel's artists in 1850 erred in showing the flowers to have free petals; they are closely imbricate and fall as a sort of calyptra in both the Utrecht fragment that Miquel retained, and the more ample sheet at Leiden. Other collections from Borneo, besides the Korthal's original one, are *Abdul Rasjid 2437, Winkler 3388, Endert 1584, Clemens 22295, Boschproefstation 14167, 14661;* there are many Malay Peninsula collections. The species is as yet known from the Philippines only by the single Palawan collection cited; it is apparently common in Borneo and in the Malay Peninsula, and should occur in Sumatra. The geographic range is a logical one.

SYZYGIUM BRACHYURUM sp. nov.

§ *Jambosæ*. Arbor glaberrima, ramis ramulisque teretibus, ultimis circiter 1 mm. diametro, floribus 8–10 mm. diametro, depauperato-fasciculatis, graciliter pedicellatis, pedicellis e tuberculis lignosis 3–7 mm. diametro, in ramulis infra foliis dispositis; foliis chartaceis vel subcoriaceis, opacis, oblongis, supra olivaceis, subtus paullo pallidioribus, glanduloso-punctatis, glandulis numerosis, 8–12.5 cm. longis, 1.5–3 cm. latis, basi late acutis vel subrotundato-obtusis, apice subabrupte subcaudato-acuminatis, acuminibus obtusis vel subacutis, angustis, 5–10 mm. longis; nervis primariis utrinque 25–30, inter se 3–5 mm. distantibus, distinctis sed haud perspicuis, subpatulis, in venam submarginalem 2–3 mm. a margine confluentibus, retuculis sublaxis, haud perspicuis; petiolo 2–3 mm. longo; tuberculis floriferis lignosis, subglobosis, irregulariter sublobatis, 3–7 mm. diametro, floribus paucis gerentibus; floribus ut videtur albidis, 4–meris, 8–10 mm. diametro, graciliter pedicellatis, pedicellis 1–floris circiter 1.5 cm. longis, sursum bracteolis 1 vel 2, minutis ovatis obtusis vix 0.3 mm. longis gerentibus, calycis tubo late infundibuliformis circiter 3 mm. diametro, deorsum abrupte angustato, lobis ellipticis, rotundatis, punctato-glandulosis, 3 mm. longis, 2.5 mm. latis; petalis ellipticis vel late oblongo-ellipticis liberis, patulis, obtusis, circiter 4 mm. longis et 2.5 mm. latis, consperse glanduloso-punctatis; staminibus multiseriatis, filamentis interioribus 1–2 mm. exterioribus ad 6 mm. longis; fructibus ignotis.

LUZON, Camarines Norte Province, Bicol National Forest Park, *Philip. Nat. Herb. 9768 Martin Lagrimas,* May 27, 1949, altitude 100 m.

Because of the slenderly pedicelled solitary to depauperate-fasciculate flowers springing from small lignified tubercles at or near the nodes on the branches and branchlets below the leaves, this species at first sight suggested *Jossinia;* dissection of the flowers, however, shows that the several-seriate stamens are borne on the calyx tube, not on an epigynous disk as in *Jossinia.* It is strikingly characterized by its vegetative and inflorescence characters, but has no close allies among the numerous Philippine species of *Syzygium,* or those of Malaysia known to me.

SYZYGIUM BREVIPANICULATUM (Merr.) comb. nov.

Eugenia brevipaniculata Merr., Philip. Jour. Sci. 11C (1916) 28, Enum. 3 (1923) 160.

Still known only from the original Sorsogon collection, *Bur. Sci. 23567 Ramos.*

SYZYGIUM BRITTONIANUM (C. B. Rob.) comb. nov.

Eugenia brittoniana C. B. Rob., Philip. Jour. Sci. 4C (1909) 398; Merr. Enum. 3 (1923) 160.

Known only from Bontoc and Benguet subprovinces, in northern Luzon, *Williams 1464, 1461, Bur. Sci. 40425 Ramos* and *Edaño.*

SYZYGIUM CAGAYANENSE (Merr.) comb. nov.

Eugenia cagayanensis Merr., Philip. Jour. Sci. 10C (1915) 214, Enum. 3 (1923) 160.

Known only from Cagayan Province, Luzon. Additional collections are *For. Bur. 29517 Aloba* from Camalingan, and *Bur. Sci. 78562 Edaño* from the Pinagsongyan River, Cagayan.

SYZYGIUM CALCICOLUM (Merr.) comb. nov.

Eugenia calcicola Merr., Philip. Jour. Sci. 10C (1915) 209, Enum. 3 (1923) 161.

Widely distributed in Luzon, the type from Benguet, *Merrill 9746, Bur. Sci. 14922, 23827 Ramos,* etc. Very similar to the low altitude *Syzygium alcinae* (Merr.) Merr.

SYZYGIUM CALLERYANUM (C. B. Rob.) comb. nov.

Eugenia calleryana C. B. Rob., Philip. Jour. Sci. 6C (1911) 348; Merr., Enum. 3 (1923) 161, *cum. syn.*

Still known only from Luzon (Abra, Benguet, Zambales, Bataan, Rizal), unless fruiting specimens from Zamboanga Peninsula, Mindanao (*Ahern* s. n.) should prove to belong here when flowering specimens from that region become available. Represented by *Elmer 6130, Loher 6040, For. Bur. 423 Ahern's collector,* etc.

SYZYGIUM CALUBCOB (C. B. Rob.) comb. nov.

Eugenia calubcob C. B. Rob., Philip. Jour. Sci. 4C (1909) 364; Merr., Enum. 3 (1923) 161, *cum. syn.*

A common species extending from the Batan Islands and northern Luzon to Palawan and Mindanao.

SYZYGIUM CANDELABRIFORME (C. B. Rob.) comb. nov.

Eugenia candelabriformis C. B. Rob., Philip. Jour. Sci. 4C (1909) 375; Merr., Enum. 3 (1923) 161.

Widely distributed in northern Luzon, extending south to Laguna and Rizal provinces, *Bur. Sci. 23823, 22689 Ramos, 37648 Ramos* and *Edaño,* etc.

SYZYGIUM CAPOASENSE (Merr.)

Eugenia capoasensis Merr., Philip. Jour. Sci. 10C (1915) 209, Enum. 3 (1923) 162.

Still known only from the type collection, *Merrill 9493* from Palawan.

SYZYGIUM CARDIOPHYLLUM (Merr.) comb. nov.

Eugenia cardiophylla Merr., Philip. Jour. Sci. 18 (1921) 305, Enum. 3 (1923) 162.

Still known only from the type collection from Mindanao (Bukidnon), *For Bur. 26534 Rola.*

SYZYGIUM CASIGURANENSE (Quis.) comb. nov.

Eugenia casiguranensis Quis., Philip. Jour. Sci. 41 (1930) 337, *fig. 12.*

This was based on *Bur. Sci. 45464 Ramos* and *Edaño* from Casiguran, Quezon Province, Luzon. Their no. *45499* from the same locality and *For. Bur. 30049 Sulit,* from the same province apparently represent the same species; also *Bur. Sci. 24312 Ramos* from Mount Irig, Rizal Province.

SYSYGIUM CAVITENSE sp. nov.

Species *S. decipienti* affinis, differt inflorescentiis multo minoribus, sub fructu vix 2.5 cm. attingentibus, foliis minoribus, 6–9 cm. longis. Arbor glabra, ramis ramulisque teretibus pallide brunneis, ultimis circiter 1 mm. diametro; foliis ellipticis vel suboblongo-ellipticis, firmiter chartaceis vel subcoriaceis, 6–9 cm. longis, 2.5–4 cm. latis, utrinque subaequaliter angustatis, basi acutis, apice obtuse acuminatis, sicco brunneis, subtus paullo pallidioribus et dense minuteque puncticulatis, opacis vel leviter nitidis; nervis primariis numerosissimis, parallelis, gracilibus, inter se circiter 2 mm. distantibus, in venam intramarginalem 1.5–2 mm. a margine confluentibus, secundariis reticulisque minus distinctis; petiolo 5–8 mm. longo; inflorescentiis lateralibus, plerumque infra foliis in axillis defoliatis, 2–2.5 cm. longis, solitariis vel subfasciculatis, breviter pedunculatis vel e basi famosis, ramis paucis (1–3), brevibus; fructibus paucis breviter pedicellatis, plerumque depresso-globosis, 7–10 mm. diametro.

LUZON, Cavite Province, *Bur. Sci. 22584 Ramos* and *Deroy,* April–May, 1915, type Gray Herbarium, isotypes Arnold Arboretum, U. S. National Herbarium, and Kew.

A species clearly allied to the Javan *Syzygium decipiens* (Koord. and Val.) Merr. and Perr. as well illustrated by Koorders and Valeton in their Atlas 3 (1915), *pl. 495,* and to the Philippine form perhaps incorrectly referred by C. B. Robinson to that species. The striking difference, aside from the smaller leaves, is found in the short infructescences of *S. cavitense*. In the original description of the Javan form the leaves are indicated as 12.5 to 14 cm. long, and the widely branching inflorescences as 20 to 30 cm. in diameter, these, like the infructescences of this Cavite form, born on the slender branches below the leaves. In the Philippine form currently referred to *S. decipiens* (Koord. and Val.) Merr. and Perr. the leaves and inflorescences are smaller than in the Javan plant, but larger than in *S. cavitense* Merr.

SYZYGIUM CILIATO-SETOSUM (Merr.) comb. nov.

Eugenia ciliato-setosa Merr., Philip. Jour. Sci. 7C (1912) 315, Enum. 3 (1923) 162.

Originally known only from Cagayan Province, Luzon. Additional collections are *Bur. Sci. 78258, 78442 Edaño* from Cagayan Province, *Bur. Sci. 45563 Ramos* and *Edaño,* and *P. N. H. 4717, 5441, Alcasid* and *Edaño* from Quezon Province, Luzon. Strikingly different from all other known Philippine species in this large genus in its characteristics indumentum.

SYZYGIUM CINNAMOMEUM (Vidal) comb. nov.

Eugenia cinnamomea Vidal, Phan. Cuming. Philip. (1885) 172; Merr., Enum. 3 (1923) 162.

LUZON (Cagayan to Albay), Mindoro. An additional collection is *P. N. H. 5640 Alcasid* and *Edaño,* from Nueva Ecija Province, Luzon. The type is *Cuming 846.*

SYZYGIUM CLAVELLATUM (Merr.) comb. nov.

Eugenia clavellata Merr., Philip. Jour. Sci. 1 Suppl. (1906) 104, Enum. 3 (1923) 162.

LUZON (Bataan to Sorsogon), Samar, Mindanao, *Merrill Philip. Pl. 1415, 1676, Elmer 15660,* etc.

SYZYGIUM CLAVIFLORUM (Roxb.) Cowan and Cowan

Syzygium claviflorum (Roxb.) Cowan and Cowan, Trees North Bengal (1929) 67; Merr. and Perr., Jour. Arnold Arb. 19 (1938) 221.

Eugenia claviflora Roxb., Hort. Beng. (1814 37 *nom. nud.,* Fl. Ind. ed. 2 2 (1832) 488 descr.; Merr., Enum. 3 (1923) 162; Henders., Gard. Bull. Singapore 12 (1949) 252, *fig. 49a. cum. syn.; Jambosa clavata* Korth. (1847); *E. rhodendrifolia* Miq. (1850); *Myrtus clavata* Korth. ex Miq., (1850); *Jambosa borneensis* Miq. (1855); *Eugenia ruminata* Koord. and Val. (1900); *E. fraseri* Ridl. (1930); *E. viridifolia* Elm. (1912); *Syzygium clavatum* Merr. and Perr. (1939); *Syzygium viridiflorum* Merr. and Perr. (1939).

BATAN ISLANDS and northern Luzon to Samar, Leyte, and Palawan and, outside of the Philippines, Sikkim and Bengal to Burma, Siam, Indo-China, southern China, Malay Peninsula, Anamba Islands, Java and Borneo.

In several of the above reductions, notably the Bornean *Syzygium clavatum* (Korth.) Merr. and Perr., and the Philippine *S. viridifolium* (Elm.) Merr. and Perr., I defer to Mr. Henderson's judgment, as he had abundant material for study. However, he interpreted *Eugenia claviflora* Roxb. as a collective species with five varieties (*leptalea* (Craib) Henders, *excavata* King, *maingayi* King, *riparia* Henders., and *montana* Henders.). It may be that several distinct species are represented in the complex as he interpreted it.

SYZYGIUM CLEMENTIS (C. B. Rob.) comb. nov.

Eugenia clementis C. B. Rob., Philip. Jour. Sci. 4C (1909) 383; Merr., Enum. 3 (1923) 163.

LUZON (Sorsogon), Panay, Mindanao, *Bur. Sci. 22151 Ramos* from Camarines Province, Luzon, apparently belongs here.

SYZYGIUM CONFERTUM (Korth.) Merr. and Perr.

Syzygium confertum (Korth.) Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 177. (Mem. Gray. Herb. 4:177); Amshoff, Blumea 5 (1945) 499.

Jambosa conferta Korth., Nederl. Kruidk. Arch. 1 (1847) 202.

Microjambosa conferta Blume, Mus. Bot. Lugd.-Bat. 1 (1849) 118.

Eugenia densepunctata Koord. and Val., Meded. Lands Plantent. 40 (1900) 97. (Bijdr. Boomsoort. Java 6:97).

Eugenia calvinii Elm., Leafl. Philip. Bot. 4 (1912) 1419; Merr., Enum. 3 (1923) 161.

Elmer 12869 from Palawan, type of *Eugenia calvinii* Elm. is the only known Philippine collection. Sumatra, Java, Borneo.

SYZYGIUM CONGESTUM (Merr.) comb. nov.

Eugenia congesta Merr., Manila, Govt. Lab. Publ. 35 (1906) 49, Enum. 3 (1923) 163.

LUZON (Benguet to Sorsogon). Additional collections are *Bur. Sci. 76256 Edaño* and *P. N. H. 2833 Convocar* from Mount Isarog, Camarines Sur Province, Luzon.

SYZYGIUM CONGLOBATUM (C. B. Rob.) comb. nov.

Eugenia conglobata C. B. Rob., Philip. Jour. Sci. 4C (1909) 859; Merr., Enum. 3 (1923) 163.

Eugenia subsulcata Elm., Leafl. Philip. Bot. 4 (1909) 359; Merr., Enum. 3 (1923) 3.

Central Luzon to Mindanao and Palawan. Additional collections are *For. Bur. 21613 Agama* from Palawan, *Bur. Sci. 48120 Ramos* and *Edaño,* Alabat, and *Wenzel 3262* from Surigao Province, Mindanao.

SYZYGIUM CONSANGUINEUM (Merr.) comb. nov.

Eugenia consanguinea Merr., Philip. Jour. Sci. **18** (1921) 300, Enum. **3** (1923) 163.

Northern Luzon (Abra). Still known only from the two original collections on which the species was based, *Bur. Sci. 26984, 26995 Ramos.*

SYZYGIUM CONSIMILE sp. nov.

Arbor parva, glabra, 6–10 m. alta, ramis ramulisque teretibus, laevibus, brunneis vel atro-brunneis, ultimis 2 mm. diametro; foliis crasse coriaceis, rigidis, ellipticis vel oblongo-ellipticis, olivaceo-brunneis vel pallide brunneis, 9–14 cm. longis, 5–7 cm. latis, leviter nitidis vel subopacis, subtus obscure consperse glandulosis, margine cartilagineis subrevolutis, basi late acutis, apice subabrupte acuminatis, acuminibus 1–1.5 cm. longis, acutis vel subobtusis, subfalcatis; nervis primariis utrinque 12–14, utrinque paullo elevatis, quam secundariis reticulisque sublaxis paullo distinctioribus, in nervam submarginalem vix 1 mm. a margine confluentibus; petiolo 10–12 mm. longo; inflorescentiis termilibus et in axillis superioribus, 4–5 cm. longis latisque, pedunculatis (pedunculo ad 2 cm. longo) vel e basi ramosis, ramis primariis paucis, plerumque circiter 1 cm. longis; floribus inter mediocris, albidis, sessilibus, in ramulis ultimis plus minusve confertis, ramulis singulis floribus 5–6 gerentibus; bracteis triangulari-ovatis, acutis vel subacutis, coriaceis, rigidis, circiter 2 mm. longis, bracteolis binis similibus sed paullo brevioribus; calycis tubo crasso, circiter 7 mm. longo, deorsum angustato sed haud pseudostipitato, ore circiter 5 mm. diametro, margine undulato; petalis valde imbricatis, plus minusve adherentibus, calyptratim deciduis; filamentis numerossimis, ad 8 mm. longis.

SAMAR, Mount Calbiga and Bagacay, near Concord, *Philip. Nat. Herb. 6341, 6442* (type) *Sulit,* May 17 and 22, 1948, on forested slopes, alt. 200–350 m. A fruiting specimen, *Whitford 1227* (Herb. Kew.) from Bataan Province, Luzon, apparently belongs here.

This species in facies closely approximates *Syzygium lacustre* (C. B. Rob.) Merr., of the Lanao region, Mindanao, and was at first taken to represent that species. It differs radically in its rather strongly developed, very coriaceous bracts and bracteoles, the latter persisting at the base of the crowded, sessile flowers. The sessile, subglobose fruits on *Whitford 1227*, mentioned above, are 1.5 to 2 cm. in diameter.

SYZYGIUM COPELANDII (C. B. Rob.) comb. nov.

Eugenia copelandii C. B. Rob., Philip. Jour. Sci. 4C (1909) 352; Merr., Enum. 3 (1923) 163.

LEYTE, Mindanao. An additional collection is *Bur. Sci. 43120 Ramos* from Bohol.

SYZYGIUM CORDATILIMBUM (Merr.) comb. nov.

Eugenia cordatilimba Merr., Philip. Jour. Sci. 27 (1925) 40.

LUZON (Rizal Province). Additional collections are *Loher 6035* from Montalban, Rizal Province and *P. N. H. 6623 Edaño* from Lake Danao, Negros.

SYZYGIUM CORTICO-PAPYRACEUM (Elm.) comb. nov.

Eugenia cortico-papyracea Elm., Leafl. Philip. Bot. 4 (1912) 1405; Merr., Enum. 3 (1923) 163.

Still known only from the type collection, *Elmer 11571* from Davao, Mindanao.

SYZYGIUM COSTULATUM (C. B. Rob.) comb. nov.

Eugenia costulata C. B. Rob., Philip. Jour. Sci 4C (1909) 393; Merr., Enum. 3 (1923) 163.

LUZON (Pangasinan to Camarines). Additional collections are *Vidal 337, 2800* (herb. Kew.) from Bataan and Camarines provinces, Luzon.

SYZYGIUM CRASSIBRACTEATUM (Merr.) comb. nov.

Eugenia crassibracteata Merr., Philip. Jour. Sci. 10C (1915) 210, Enum. 3 (1923) 164.

Still known only from the original collection, *Bur. Sci. 15358 Ramos* from Leyte.

SYZYGIUM CRASSILIMBUM (Merr.) comb. nov.

Eugenia crassilimba Merr., Philip. Jour. Sci. 27 (1925) 41.

Still known only from the original collection, *Loher 14208* from Rizal Province, Luzon.

SYZYGIUM CRASSIPES (C. B. Rob.) comb. nov.

Eugenia crassipes C. B. Rob., Philip. Jour. Sci. 4C (1909) 361; Merr., Enum. 3 (1923) 164.

A widely distributed Luzon species extending from Cagayan Province to Quezon (Tayabas). A recent additional collection is *P. N. H. 4162 Edaño* from the type locality, Lamao, Bataan Province, Luzon.

SYZYGIUM CRASSISSIMUM (Merr.) comb. nov.

Eugenia crassissima Merr., Philip. Jour. Sci. 10C (1915) 211; Merr., Enum. 3 (1923) 164.

This was based on *Bur. Sci. 15387 Ramos* from Leyte. Additional collections are *Bur. Sci. 34066 Ramos* and *Convocar.* Dinagat, and with somewhat smaller leaves, *Bur. Sci. 45656 Ramos* and *Edaño* from Nueva Vizcaya Province, *Bur. Sci. 42224 Ramos* from Mt. Lumutan, Rizal Province (distributed as a new species, the specific name derived from that of the mountain), and *P. N. H. 4530 Alcasid* and *Edaño* from Mt. Camatis, Quezon Province, Luzon.

SYZYGIUM CUMINI (Linn.) Skeels

Syzygium cumini (Linn.) Skeels, U. S. Dept. Agr. Bull. 248 (1912) 25.

Myrtus cumini Linn., Sp. Pl. (1753) 471.

Eugenia cumini Druce, Bot. Excl. Club 3 (1914) 418; Merr., Enum. 3 (1923) 164, *cum. syn.*

A species of very wide distribution in the tropics of both hemispheres, commonly known as *Eugenia jambolana* Lam. (*Syzygium jambolanum* DC.). Native of the Indo-Malaysian region, of prehistoric introduction into the Philippines where it now occurs as a naturalized species in most islands and provinces.

SYZYGIUM CURRANII (C. B. Rob.) comb. nov.

Eugenia curranii C. B. Rob., Philip. Jour. Sci. 4C (1909) 351; Merr., Enum. 3 (1923) 164.

LUZON (Laguna, Camarines), Samar. One of the species with large leaves, sharply 4-angled and usually narrowly winged branchlets, and fascicled cauline inflorescences born on small tubercles. A recent collection is *P. N. H. 6888 Sulit* from Laguna Province, Luzon.

SYZYGIUM CURTIFLORUM (Elm.) comb. nov.

Eugenia curtiflora Elm., Leafl. Philip. Bot. 1 (1908) 328; Merr., Enum. 3 (1923) 164.

LUZON (Benguet, Laguna, Quezon). The type is *Elmer 8768* from Benguet.

SYZYGIUM DAVAOENSE (Elm.) comb. nov.

Eugenia davaoensis Elm., Leafl. Philip. Bot. 4 (1912) 1439; Merr., Enum. 3 (1923) 165.

A species known only from the original collection, *Elmer 11342*, Davao, Mindanao.

SYZYGIUM DECIPIENS (Koord. and Val.) Merr. and Perr.

Syzygium decipiens (Koord. and Val.) Merr. and Perr., Jour. Arnold Arb. **23** (1942) 281; Amshoff in Backer, Beknopte Fl. Jav. Afl. IVB(I): Myrt. (1944) 16, and in Blumea **5** (1945) 497.

Eugenia decipiens Koord. and Val., Bull. Inst. Bot. Buitenz. **2** (1899) 6, Meded. Lands Plantent. **40** (1900) 181. (Bijdr. Boomsoort. Java 3:181), Atlas Baumart. Java **3** (1915) *pl. 495;* C. B. Rob., Philip. Jour. Sci. 4C (1909) 386; Merr., Enum. **3** (1923) 165.

LUZON (Bataan), *For. Bur. 1184 Borden, 2781 Meyer.* Java, Solomon Islands, New Guinea.

The leaves and inflorescences of the Philippine and Solomon Islands specimens are smaller than are those of the Javan type. The discontinuous distribution is somewhat disconcerting, suggesting that more than one species may be represented; see note under *Syzygium cavitense* Merr., *supra.* I have no Javan specimens.

SYZYGIUM DENSINERVIUM (Merr.) comb. nov.

Eugenia densinervia Merr., Philip. Jour. Sci. **1** Suppl. (1906) 105, Enum. **3** (1923) 165.

Eugenia silvestrei Elm., Leafl. Philip. Bot. **8** (1918) 3095.

Central and southern Luzon, Mindoro, *Elmer 16771, 18011, Bur. Sci. 26436 Ramos* and *Edaño,* etc. The type of *E. densinervia* Merr. was from Bataan Province; that of *E. silvestrei* Elm. was from Laguna Province, Luzon. I see no reason for distinguishing the latter. The species is very closely allied to the widely distributed Indo-Malaysian *Syzygium fastigiatum* (Blume) Merr. and Perr.

SYZYGIUM DIFFUSIFLORUM nom. nov.

Eugenia diffusa Merr., Philip. Jour. Sci. **18** (1921) 301, Enum. **3** (1923) 165, non Turr. (1915), non *Syzygium diffusum* Merr. and Perr. (1942).

A Philippine endemic known only from the original collection, *Bur. Sci. 27155 Ramos,* Ilocos Norte Province, Luzon.

SYZYGIUM DURUM (Merr.) comb. nov.

Eugenia dura Merr., Philip. Jour. Sci. 11C (1916) 24, Enum **3** (1923) 165.

Southern Luzon (Camarines, Sorsogon). Closely allied to *S. malagsam* (Elm.) Merr. of Mindanao. Represented by *Bur. Sci. 23670 Ramos, 33455 Ramos* and *Edaño, Elmer 16007, 17320.*

SYZYGIUM EBALOII sp. nov.

Jambosae. Arbor glabra circiter 8 m. alta, ramis pallidis, teretibus, floriferis 8 mm. diametro; foliis magnis, oblongis, chartaceis vel subcoriaceis, utrinque olivaceis, subtus paullo pallidioribus, epunctatis, opacis, 30–55 cm. longis, 9–12 cm. latis, ut videtur acuminatis, basi cuneatis; nervis primariis utrinque circiter 18, inter se 1.5–3 cm. distantibus, supra inconspicuis, subtus elevatis, perspicuis, curvatis, in venam intramarginalem circiter 3 mm. a margine arcuato-confluentibus, reticulis inconspicuis; petiolo circiter 2.5 cm. longo; inflorescentiis axillaribus vel e axillis defoliatis, brevibus, circiter 2.5 cm. longis, e basi ramosis, paucifloris, bracteis nullis vel deciduis; floribus mediocris, breviter pedicellatis, rubris; calycibus infundibuliformibus, tubo deorsum angustato, circiter 8 mm. longo, sursum ampliato, ore 6 mm. diametro; sepalis 4, subpatulis, brunneo-glandulosis, triangulari-ovatis, acutis, 4 mm. longis; petalis ovatis, 1 cm. longis, brunneo-punctatis; filamentis numerosis, 1.5 cm. longis.

BASILAN, Isabela de Basilan, *Ebalo 930*, January 5–18, 1941, locally known as *tubal.*

I know of no close allies among the Philippine and Malaysian species to this distinctly striking form. It is well characterized by its large, elongated leaves and its short, lateral inflorescences.

SYZYGIUM ECOSTULATUM (Elm.) comb. nov.

Eugenia ecostulata Elm., Leafl. Philip. Bot. **4** (1912) 1428; Merr., Enum. **3** (1923) 165.

A species still known only from the type collection, *Elmer 13102,* from Palawan.

SYZYGIUM ELLIPTIFOLIUM (Merr.) comb. nov.

Eugenia elliptifolia Merr., Philip. Jour. Sci. **18** (1921) 291; Merr., Enum. **3** (1923) 165.

A species still known only from the two original collections from Polillo and Catanduanes, *Bur. Sci. 30518 Ramos, Warburg 13941.*

SYZYGIUM ELLIPTILIMBUM (Merr.) Merr. and Perr.

Syzygium elliptilimbum Merr. and Perr., Mem. Am. Acad. Arts Sci. **18** (1939) 187. (Mem. Gray Herb. 4:187).

Eugenia elliptilimba Merr., Jour. Straits Branch Roy. As Soc. **77** (1917) 211, Enum. **3** (1923) 165; Quis., Philip. Jour. Sci. **41** (1930) 29. descr. fruct.

Eugenia suluensis Merr., Philip. Jour. Sci. **30** (1926) 416 *syn. nov.*

This was originally described from Bornean specimens. It occurs in the Sulu Archipelago (*E. suluensis* Merr.), and in southeastern Mindanao (Zamboanga). The type of *Eugenia suluensis* Merr. was *Bur. Sci. 43916 Ramos* and *Edaño* from

Jolo. Other specimens are *Bur. Sci. 36604, 36605, 36638 Ramos* and *Edaño* from Zamboanga Province, Mindanao.

SYZYGIUM ESCRITORII nom. nov.

Eugenia euphlebia Merr., Philip. Jour. Sci. 10C (1915) 217, Enum. 3 (1923) 166, non Hayata (1913).

A species still known only from Quezon Province, Luzon. The type is *Bur. Sci. 20782 Escritor.*

The original specific name selected by me is invalidated by the earlier *Eugenia euphlebia* Hay. Ic. Pl. Formos. 3 (1913) 119= *Syzygium euphlebium* (Hay.) Mori, Trans. Nat. Hist. Soc. Formosa 28 (1938) 439, a Formosan species.

SYZYGIUM EVERETTII (C. B. Rob.) comb. nov.

Eugenia everettii C. B. Rob., Philip. Jour. Sci. 4C (1909) 371; Merr., Enum. 3 (1923) 166, excl. *Eugenia irosinensis* Elm.)
Eugenia pallidifolia Merr., Philip. Jour. Sci. 10C (1915) 222.

Central to southern Luzon, Leyte, Negros, Mindanao. An additional collection is *P. N. H. 2743 Sulit* from Sorsogon Province, Luzon. It has been recorded, with doubt as occurring in the Talaud Islands south of Mindanao. *Eugenia irosinensis* Elm. is apparently a distinct species, my reduction of it in 1923 being erroneous.

SYZYGIUM FASTIGIATUM (Blume) Merr. and Perr.

Syzygium fastigiatum (Blume) Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 152. (Mem. Gray Herb. 4:152), *cum syn.*
Calyptranthes fastigiata Blume, Bijdr. (1826) 1090.
Caryophyllus fastigiatum Blume, in DC. Prodr. 3 (1828) 262.
Eugenia bracteolata Wight, Ill. 2 (1841) 15, Ic. 2 (1843) *pl. 531.*
Eugenia confertiflora Koord. and Val., Meded. Lands Plant. 40 (1900) 106; (Bijdr. Boomsoort. Java 6:106); Atlas Baumart. Java 3 (1915) *pl. 480,* non A. Gray (1854).
Eugenia fastigiata Koord. and Val., op. cit. 104; Atlas. *pl. 479;* Henders. Gard. Bull. Singapore 12 (1949) 190. *fig. 36c.*
Eugenia elmeri Merr., Univ. Calif. Publ. Bot. 15 (1919) 218.
Eugenia sablanensis Elm., Leafl. Philip. Bot. 1 (1908) 228; Merr., Enum. 3 (1923) 176, incl. var. *ramulosa* Elm.; op. cit. 4 (1912) 1408, *syn. nov.*

Widely distributed in the Philippines, and outside of that Archipelago extending from Tenasserim, Burma, Siam and Indo-China through the Malay Peninsula to Sumatra, Java, and Borneo. It is suspected that the synonymy as given above, and by other authors, will be increased rather than diminished as collections now available are more thoroughly studied. The Moluccan *Eugenia rumphii* Merr. Interpret. Rumph. Herb. Amb. (1917) 396, with larger flowers like those of *Syzygium densinervium* (Merr.) Merr., and somewhat smaller leaves than the species here considered, belongs in this group. The Index Kewensis entry *Eugenia confertifolia* A. Gray is an error for E. *confertiflora* A. Gray.

SYZYGIUM FENICIS (C. B. Rob.) comb. nov.

Eugenia fenicis C. B. Rob., Philip. Jour. Sci. 4C (1909) 355; Merr., Enum. 3 (1923) 166.

The type was from the Babuyan Islands, *Bur. Sci. 4065 Fenix*, *Bur. Sci. 29680 Ramos* from Rizal Province, Luzon is referred here.

SYZYGIUM FILIPES sp. nov.

Ut videtur arbor parva, glabra, ramis ramulisque gracilibus, teretibus, ultimis vix 1 mm. diametro, vetustioribus griseis, rigidis; foliis subellipticis vel oblongo-ellipticis, coriaceis, supra olivaceis vel brunneo-olivaceis, supra nitidis, subtus pallidioribus et minute subdense puncticulatis, 5–7 cm. longis, 1.5–3 cm. latis, longe graciliter subabrupte caudato-acuminatis, acuminibus 1-2 cm. longis, obtusis, 1.5–2 mm. latis, basi acutis vel late acutis; nervis utrinque numerosissimis, parallelis, patulis, inter se circiter 1 mm. distantibus, vix perspicuis, in venam intramarginalem 1 mm. a margine confluentibus; petiolo 6–10 mm. longo; inflorescentiis in axillis superioribus, haud terminalibus, laxissimis, trichotomis, gracilibus, pedunculatis, paucifloris, 5–9 cm. longis, 3–4 cm. latis, pedunculo circiter 3.5 cm. longo, ramis primariis 1.5–2 cm. longis, gracilibus, fere filiformibus; floribus inter minores, in ramis primariis et secundariis in triadibus dispositis, bracteis lanceolatis, deciduis, circiter 1 mm. longis, bracteolis similibus, minoribus; calycibus 3–3.5 mm. longis, vix 1.5 mm. diametro, truncatis vel margine obscure undulatis, deorsum gradatim angustatis, sessilibus vel brevissime pedicellatis; petalis 4, circiter 1 mm. diametro, imbricatis sed vix cohaerentibus.

MINDANAO, Surigao Province, *Bur. Sci. 34723 Ramos* and *Edaño*, June, 1919, distributed as *Eugenia cymosa* Lam., var. Type in the herbarium of the Arnold Arboretum, duplicate in the U. S. National Herbarium.

Strikingly characterized by its very slender branches and branchlets, its closely veined, conspicuously caudate-acuminate leaves which are rather densely puncticulate beneath, and especially by its very lax, few flowered inflorescences which are borne in the upper leaf axils, the peduncles and branches being filiform. The small, almost clavate flowers are not quite mature. I have not been able to refer this to any described Malaysian or

Philippine form. Its original identification with Lamarck's species was erroneous and the Malaysian material formerly referred to *Eugenia cymosa* Lam. for the most part represents *Syzygium syzygioides* (Miq.) Merr. and Perry. The true alliance of *Syzygium filipes* Merr. appears to be with the Sumatran, Javan and Bornean *Syzygium rostratum* (Blume) DC. but the very lax inflorescences forbid this disposition of the Philippine form. *Eugenia cymosa* Lam. does not occur in the Indo-Malaysian region; its type was from Mauritius.

SYZYGIUM FISCHERI (Merr.) comb. nov.

Eugenia fischeri Merr., Philip. Jour. Sci. 10C (1915) 218, Enum. 3 (1923)166.

A species still known only from three collections, Camarines Province, Luzon, *For. Bur. 21755 Fischer, 21228 Alvarez, 21153 Miranda.*

SYZYGIUM FOXWORTHYI (Elm.) comb. nov.

Eugenia foxworthyi Elm., Leafl. Philip. Bot. 4 (1912) 1414; Merr., Enum. 3 (1923) 166.

A species still known only from the type collection, *Elmer 11280* from Davao, Mindanao.

SYZYGIUM GARCIAE (Merr.) comb. nov.

Jambosa garciae Merr., Manila, Govt. Lab. Publ. 17 (1904) 36.
Eugenia garciae Merr. ex C.B. Rob., Philip. Jour. Sci. 4C (1900) 399; Enum. 3 (1923) 166.

A very strongly marked species extending from Mindoro and southern Luzon (Sorsogon), to Mindanao. A recent collection is *P.N.H. 2080 Quisumbing* from Baler, Quezon Province, Luzon.

SYZYGIUM GIGANTIFOLIUM (Merr.) comb. nov.

Eugenia gigantifolia Merr. ex C. B. Rob., Philip. Jour. Sci. 4C (1909) 350; Merr., Enum. 3 (1923) 166.

A species recorded from Culion, Mindoro, Mindanao, and Basilan. *Bur. Sci. 46224 Edaño* from Panay apparently belongs here.

SYZYGIUM GITINGENSE (Elm.) comb. nov.

Eugenia gitingensis Elm., Leafl. Philip. Bot. 4 (1912) 1409; Merr., Enum. 3 (1923) 166.

LUZON (Cagayan, Camarines), Sibuyan. The type is *Elmer 12078* from Sibuyan.

SYZYGIUM GLAUCICALYX (Merr.) comb. nov.

Eugenia glaucicalyx Merr., Manila, Govt. Lab. Publ. 35 (1906) 50, Enum. 3 (1983) 166.

LUZON (Bataan, Laguna), Culion, Palawan, *Merrill 570,626, 3949, For. Bur. 817, 826, Borden, 7359, 6241, 19282 Curran.*

This may be the Philippine representative of the Indo-Malaysian *Syzygium zeylanicum* (Linn.) DC. (*Eugenia spicata* Lam.), although as Henderson notes, Gard. Bull. Singapore 12 (1949) 233, it is closer to the allied *Syzygium gratum* Wall. (*Eugenia grata* Wight), which extends from Assam and Burma to Malay Peninsula and Sumatra. The Philippine form is an inland, usually sylvan species, rather than a coastal one.

SYZYGIUM GLOBOSUM (Elm.) comb. nov.

Eugenia globosa Elm., Leafl. Philip. Bot. 4 (1912) 1404; Merr., Enum. 3 (1923) 167.

Eugenia banaba Elm., op. cit. 1443; Merr. op. cit. 159, *syn. nov.*

A comparison of *Elmer 11702, 11327* from Davao, Mindanao, the two collections on which *Eugenia globosa* Elm. was based with *Elmer 12146* from Sibuyan, the type collection of *Eugenia banaba* Elm., indicates rather clearly that but a single species is represented. An additional collection is *Vidal 2765* (Herb. Kew.) from Panay.

SYZYGIUM GRACILE (Korth.) Amsh.

Syzygium gracile (Korth.) Amsh., in Backer, Beknopte Fl. Jav. *IVb (1) 6:* Fam. 98 Sept. (1944) 22, Blumea 5 Dec. 31 (1945) 500.

Jambosa gracilis Korth., Nederl. Kruidk. Arch. 1 (1847) 202.

Myrtus glabrata Blume, Bijdr. (1788) 1088. 1826, non Sw.

Clavimyrtus virens Blume, Mus. Bot. Lugd. Bat. 1 (1849) 114.

Clavimyrtus marginata Blume, op. cit. 115.

Jambosa marginata Miq., Fl. Ind. Bat. 1 (1855) 428.

Jambosa virens Miq., l. c.

Eugenia fusiformis Duthie, in Hook. f. Fl. Brit. Ind 2 (1878) 479.

Eugenia blumeana O. Kuntze, Rev. Gen. Pl. 1 (1891) 289.

Eugenia virens Koord. and Val., Meded. Lands Plant. 40 (1900) 113 (Bijdr. Boomsoort. Java 6:113); Henders. Gard. Bull. Straits Settl. 12 (1949) 249, *fig. 47a.*

Eugenia clavimyrtus Koord. and Val., l. c.

Eugenia leptogyna C. B. Rob., Philip. Jour. Sci. 4C (1909) 368; Merr., Enum. 3 (1923) 186.

Syzygium fusiforme Merr. and Perr., Mem. Amer. Acad. Arts Sci. 18 (1939) 176; (Mem. Gray Herb. 4:176).

Central Luzon (Laguna) to Mindoro, Palawan, Panay Negros, and Mindanao. A recent Philippine collection is *Philip. Nat. Herb. 2731 Sulit* from Sorsogon Province, Luzon. A very characteristic species represented by many collections, extending to Borneo, Java, and the Malay Peninsula.

This strongly marked species has acquired an extensive synonymy since it was first very inadequately described by Blume from Javan specimens in 1826. As is not infrequently the case when it appeared in collections from the Malay Peninsula it was redescribed as a new species, and still later when it was found in the Philippines it was again described as another new species. Mr. Henderson was fortunately able to examine Blume's type of *Clavimyrtus virens* Blume (1849), and I examined it in 1950. However, Dr. Amashoff noted in 1945 that the oldest valid specific name for the species in *Syzygium* stems from *Jambosa gracilis* Korth. (1847), and after having also seen the Korthals type, I accept her conclusions. The synonymy as given above is taken largely from Henderson and Amshoff.

Koorders and Valeton took their descriptive data from Blume and thought that the species might not be distinct from their very different *Eugenia clavimyrtus* Koord. and Val. Mr. Henderson was fortunately able to examine Blume's type and I here accept his interpretation of it. I have not, however, been able to locate any consideration of Blume's name in Amshoff's recent revision of the Javan species in Backer's Beknopte Flora van Java (1944), yet Blume's type was from Java.

SYZYGIUM GRISEUM (C. B. Rob.) Airy Shaw.

Syzygium griseum (C. B. Rob.) Airy Shaw, Kew Bull. (1949) 124.
Eugenia grisea C. B. Rob., Philip Jour. Sci. 4C (1909) 395; Merr., Enum. 3 (1923) 167.

A species recorded from northern to southern Luzon (Cagayan to Camarines), Guimaras, and Leyte; also in Borneo, fide Airy Shaw. Additional Philippine collections are *Bur. Sci. 22011 Ramos* from Camarines Province, *For. Bur. 28881 Cenabre* and *Aglear,* Cagayan Province, *P. N. H. 2284 Quisumbing,* Quezon (Tayabas) Province, *Loher 350, 2485* (Herb. Kew.) from Central Luzon, *Loher 2485, 7262* (Herb. Kew.) Rizal Province, and *P. N. H. 6267 Sulit* from Samar.

As Robinson and Airy Shaw note, this species is apparently closely allied to the Javan *Eugenia jamboloides* Koord. and Val. Meded. Lands Plantent. 40 (1900) 136. (Bijdr. Boomsoort. Java 6:136) *Syzygium racemosum* (Blume) DC. Prodr. 3 (1828) 261. (*Calyptranthes racemosa* Blume, Bijdr. (1826) 1089).

SYZYGIUM HALOPHILUM (Merr.) comb. nov.

Eugenia halophila Merr., Enum. 3 (1923) 167.
Eugenia maritima Merr., in Philip. Jour. Sci. 10C (1915) 212, non DC. (1828).

The type, *For. Bur. 13760* (not *13670* as cited in the original description) *Foxworthy, Demesa* and *Villamil,* was from

Zamboanga, Mindanao, but sterile material from Luzon (Cagayan, Camarines) and Leyte may represent the same species. It is also recorded from Banguey Island, British North Borneo.

SYZYGIUM HUGHCUMINGII sp. nov.

Ut videtur arbor parva, glabra, ramis teretibus, pallide brunneis, ramulis ultimis circiter 1 mm. diametro, sulcato-angulatis vel obscure 4–carinatis; foliis subellipticis vel oblongo-ellipticis, 12–14 cm. longis, 4–6 cm. latis, breviter obtuse acuminatis, basi acutis, olivaceo-brunneis, supra subnitidis, subtus paullo pallidioribus, obscure puncticulatis, firmiter chartaceis, vix coriaceis, breviter (3–4 mm.) petiolatis; nervis primariis utrinque circiter 14, inter se plerumque 6–9 mm. distantibus, distinctis, patulis vel leviter adscendentibus, in venam submarginalem circiter 2 mm. a margine confluentibus, secundariis minus distinctis, omnibus cum reticulis sublaxis subtus subelevatis; inflorescentiis terminalibus, sessilibus vel breviter pedunculatis, 4–5 cm. longis latisque, plerumque e basi ramosis, ramis, primariis 1–2.5 cm. longis; floribus inter minores, sessilibus, in ramulis ultimis in capitulis 5–10-floris dispositis; bracteis inferioribus sublanceolatis, acuminatis, superioribus brevioribus, bracteolis minutis, obscuris, deciduis; calycibus 4 mm. longis, obscurissime striatulis, ore circiter 3 mm. diametro, truncato, deorsum angustatis sed vix pseudostipitatis; petalis calyptratim caducis, filamentis numerosis; stylo circiter 5 mm. longo.

LUZON, Camarines Sur Province, *Hugh Cuming 1498*, type in herb. British Museum; also from Laguna Province, *N. J. Anderson s. n.* January, 1853, Stockholm and Arnold Arboretum herbaria. Another collection, with somewhat narrower leaves than the type is *Micholitz s.n.*, in the Kew Herbarium with merely the entry "Philippines"; this probably came from either southern Quezon (Tayabas) Province or from Camarines, see below.

A species clearly allied to *Syzygium striatulum* (C. B. Rob.) Merr., but distinguished by several characters, among these being its more distant and essentially spreading rather than distinctly ascending nerves, and its much smaller flowers, which, instead of being arranged in triads, are crowded into small 5– to 10-flowered capitula at the tips of the ultimate branchlets of the inflorescences. The Cuming number was unlocalized on the British Museum sheet. It came from Camarines Sur Province, Luzon (see Merrill, Philip. Jour. Sci. 30 (1926) 175). The unlocalized Micholitz specimen undoubtedly came from either Camarines or southern Quezon Province, Luzon, as these particular areas were the favorite places in the Philippines where that professional orchid collector operated.

SYZYGIUM HUTCHINSONII (Merr.) comb. nov.

Eugenia hutchinsonii Merr. ex C. B. Rob., Philip. Jour. Sci. **4C** (1909) 376; Merr., Enum. **3** (1923) 167.

Still known only from the type collection, *For. Bur. 4026 Hutchinson* from Basilan.

SYZYGIUM ILOCANUM (Merr.) comb. nov.

Eugenia ilocana Merr., Philip. Jour. Sci. **18** (1921) 291, Enum. **3** (1923) 167.

Still known only from the two original collections from Ilocos Norte Province, Luzon, *Bur. Sci. 27420, 32821 Ramos.*

SYZYGIUM INCARNATUM (Elm.) Merr. and Perr.

Syzygium incarnatum (Elm.) Merr. and Perr., Mem. Am. Acad. Arts Sci. **18** (1939) 195. (Mem. Gray Herb. **4**: 195).

Eugenia incarnata Elm., Leafl. Philip. Bot. **4** (1912) 1416.

The type of this was *Elmer 13231* from Palawan, a fruiting specimen. In association with Dr. Perry a number of Bornean collections were referred to this species, I still think correctly so. However, we also reduced to this species *Eugenia punctulata* King (1901), non F. M. Bailey (1896) (*Syzygium punctulatum* Wall. (1831), *nomen nudum*), of the Malay Peninsula. Henderson, Gard. Bull. Singapore **12** (1949) 168, does not agree with this reduction and proposed *Eugenia cerina* Henders. as a new name for the Malay Peninsula form. The two species are manifestly closely allied, but additional Philippine collections are needed to settle the point at issue. In any case *Syzygium incarnatum* (Elm.) Merr. and Perr. is the correct name for the Philippine form.

SYZYGIUM INCRASSATUM (Elm.) comb. nov.

Eugenia incrassata Elm., Leafl. Philip. Bot. **2** (1901) 581; Merr., Enum. **3** (1923) 167.

Eugenia camiguinensis Merr., Philip. Jour. Sci. 7C (1912) 314, Enum. **3** (1923) 161, *syn. nov.*

A species manifestly allied to *S. densinervium* Merr., but with smaller, very differently shaped, distinctly glandular-punctate leaves. I am now convinced that *Eugenia camiguinensis* Merr. is the same as *Syzygium incrassatum* (Elm.) Merr. and accordingly reduce it to synonymy. The species as thus constituted is known from the two original collections, *Elmer 9187* from Lucban, Mount Banahao, Quezon Province, Luzon (at least some of the duplicates of this number were distributed with Dumaguete, Negros labels; but the Lucban locality is correct, as it was checked on the typed copy of Elmer's notes in the Arnold Arboretum library), typifies *S. incrassatum* (Elm.) Merr., and *Merrill Philip. Pl. 1175* from Camiguin de Misamis Island, collected by Ramos, typifies *Eugenia camiguinensis* Merr. A third and more recent collection is *P. N. H. 6340 Sulit* from Samar, May 17, 1948.

SYZYGIUM INTUMESCENS (C. B. Rob.) comb. nov.

Eugenia intumescens C. B. Rob., Philip. Jour. Sci. 4C (1909) 401; Merr., Enum. 3 (1923) 167.

Northern Luzon (Isabela) to Masbate, Leyte, and Camiguin de Misamis. An additional collection is *Bur. Sci. 17578 Ramos* from Samar.

SYZYGIUM IROSINENSE (Elm.) comb. nov.

Eugenia irosinensis Elm. ex Merr., Enum. 3 (1923) 166, *nom.* sub *Eugenia everettii* Merr., Elm., Leafl. Philip. Bot. 10 (1939) 3767, *descr. angl.*

Jambosae, Arbor glabra, circiter 8 m. alta, ramis ramulisque teretibus, plerumque pallidis, ultimis 1–1.5 mm. diametro; foliis ovatis, elliptico-ovatis, vel oblongo-ovatis, subchartaceis, 8–11 cm. longis, 3–6 cm. latis, sicco supra plerumque subolivaceis vel pallidis, subtus pallidioribus et minute atro-puncticulatis, basi late acutis vel subrotundatis, apice distincte sed obtuse acuminatis; nervis primariis utrinque 4–6, distantibus, subtus elevatis, distinctis, curvatis, arcuato-anastomosantibus, reticulis primariis laxis; inflorescentiis terminalibus et in axillis superioribus, pedunculatis (pedunculo 2–5 cm. longo fide Elmer), ramis paucis, pedicellis sub fructu 8–15 mm. longis; fructibus (immaturis) cyathiformibus, basi late rotundatis, saltem 1.5 cm. longis latisque, tubo producto, margine distincte recurvatis; stylo fere 2 cm. longo; floribus ignotis.

LUZON, Sorsogon Province, Mount Bulusan, *Elmer 15600* (type), *15274, 16341,* November, 1915 and June, 1916, in forest at medium altitudes.

In 1923 I cited Elmer's then unpublished binomial as a synonym of *Eugenia everettii* C. B. Rob. In Leafl. Philip. Bot. 10 (1939) 3808, Elmer listed his no. *16341,* distributed as *Eugenia irosinensis* Elm., which I believe it to represent, as *E. everettii* C. B. Rob. I take *Syzygium irosinense* (Elm.) Merr. to be a species distinct from but manifestly allied to *Syzygium everettii* (C. B. Rob.) Merr.; it is safely not closely allied to *Syzygium balerense* (C. B. Rob.) Merr., as Elmer suggested. It is distinguished from *Syzygium everettii* (C. B. Rob.) Merr., among other characters, by its usually peduncled inflorescences (fide Elmer), its distinctly pedicelled fruits, and especially by its fewer nerved leaves. I have examined six sheets of the Elmer numbers cited but all of these are unsatisfactory, with detached fragmentary infructescences and detached fruits, the latter very immature—in fact just beyond anthesis. This is a case where I should not have attempted to characterize a species on the basis of fragmentary, rather poorly prepared specimens had not Mr. Elmer published his English description in 1939. The present publication of an admittedly unsatisfactory Latin description at least validates Elmer's binomial.

SYZYGIUM ISABELENSE (Quis.) comb. nov.

Eugenia isabelensis Quis., Philip. Jour. Sci. 41 (1930) 339, *fig. 13*.

This species was based on *Bur. Sci. 46973, 47218 Ramos* and *Edaño*, from Isabela Province, Luzon. Additional collections are *For. Bur. 18492 Alvarez* from Cagayan Province, and *Bur. Sci. 33455 Ramos* and *Edaño* from Camarines Province, Luzon, the latter distributed as *Eugenia dura* Merr. fol. major.

SYZYGIUM IWAHIGENSE (Elm.) comb. nov.

Eugenia iwahigense Elm., Leafl. Philip. Bot. 4 (1912) 1417; Merr., 6 Suppl. (1931) 116.

Still known only from the type collection, *Elmer 12743* (not *12742*), from Palawan.

SYZYGIUM JAMBOS (Linn.) Alston

Syzygium jambos (Linn.) Alston, in Trimen Handbook Fl. Ceylon 6 Suppl. (1931) 116.

Eugenia jambos Linn., Sp. Pl. (1753) 470; Merr., Enum. 3 (1923) 168, *cum syn.*

Widely distributed in the Philippines, cultivated and naturalized, of prehistoric introduction here. Native of the Indo-Malaysian region, now pantropic. Its present wide geographic distribution is largely due to its having been disseminated by man at an early period in the Old World, for its edible fruits. In parts of Central America it is now gregarious over considerable areas.

SYZYGIUM LACUSTRE (C. B. Rob.) comb. nov.

Eugenia lacustris C. B. Rob., Philip. Jour. Sci. 4C (1909) 377; Merr., Enum. 3 (1923) 168.

This was based on *Clemens 299* from Lanao Province, Mindanao, the species again collected in the same region by *For. Bur. 23316 Agama*. A recent collection is *P.N.H. 10101 Sulit* from Bukidnon Province, Mindanao.

SYZYGIUM LANCILIMBUM (Merr.) comb. nov.

Eugenia lancilimba Merr., Philip. Jour. Sci. 20 (1922) 413, Enum. 3 (1923) 168.

A species still known only from the original two collections, *Bur. Sci. 36934, 36935 Ramos* and *Edaño,* from Zamboanga Province, Mindanao.

SYZYGIUM LEUCOXYLUM Korth.

Syzygium leucoxylum Korth., Nederl. Kruidk. Arch. 1 (1847) 203; Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 193. (Mem. Gray Herb. 4: 193).
Eugenia leucoxylon Miq., Anal. Bot. Ind. 1 (1850) 26, *pl. 9;* Henders. Gard. Bull. Singapore 12 (1949) 285, *fig. 44j.*
Singapore 12 (1949) 285, *fig. 44j.*
Eugenia verecunda Duthie, in Hook. f. Fl. Brit. Ind. 2 (1878) 496.
Eugenia brevistylis C. B. Rob., Philip. Jour. Sci. 6C (1911) 347; Merr., Enum. 3 (1923) 160.

This species extends from the Malay Peninsula, the Anambas Islands and Borneo to the Philippines. In the latter group it had previously been recorded from Luzon (Quezon Province), Sibuyan, Leyte, Tinago, Dinagat, and Mindanao. Recent collections are *P. N. H. 3708 Salvosa* from Palasan, and *P. N. H. 131, 213 Edaño* from Palawan.

SYZYGIUM LEYTENSE (Elm.) comb. nov.

Eugenia leytensis Elm., Leafl. Philip. Bot. 1 (1908) 329; Merr., Enum. 3 (1923) 169
Eugenia samarensis Merr., Philip. Jour. Sci. 10C (1915) 223, Enum. 3 (1923) 176, *syn. nov.*
Eugenia sarcocarpa Merr., Philip. Jour. Sci. 18 (1921) 295, Enum. l. c., *syn. nov.*

Now represented by seven individual collections from Leyte and Samar. The type of *Eugenia sarcocarpa* Merr. is a fruiting specimen and I am now convinced that both this species and *E. samarensis* Merr. are the same as *E. leytensis* Elm.

SYZYGIUM LLANOSII (Merr.) comb. nov.

Eugenia llanosii Merr., Philip. Jour. Sci. 10C (1915) 220, Merr., Enum. 3 (1923) 169.

A species still known only from the type collection, *Merrill 9704* from Benguet Province, Luzon.

SYZYGIUM LONGIFLORUM Presl

Syzygium longiflorum Presl, Bot. Bemerk. (1844) 70.
Eugenia longiflora F.-Vill., Novis. App. Fl. Filip. (1880) 86; Merr., Enum. 3 (1923) 169; Henders., Gard. Bull. Singapore 12 (1949) 159, *fig.* [illegible]*0 e-f., cum syn.*
Eugenia marivelesensis Merr., Philip. Jour. Sci. 1 Suppl. (1906) 106.
Eugenia miquelii Elm., Leafl. Philip. Bot. 4 (1912) 1441.
Myrtus lineata Blume, Bijdr. (1826) 1087, non Sw. (1800).
Eugenia lincata Dutchie Fl. Brit. Ind. 2 (1878) 487.
Jambosa rubricaulis Miq., Fl. Ind. Bat. 1 1 (1855) 429.
Jambosa teysmanni Miq., l.c.

Eugenia rubricaulis Duthie., in Hook f. Fl. Brit. Ind. 2 (1878) 487.
Eugenia similaris King, Jour. As. Soc. Bengal 70 (2) (1901) 128. (Mater. 3:558); pro parte.
Eugenia longicalyx Ridl., Jour. Bot. 68 (1930) 11.
Syzygium lineatum Merr. and Perr., Jour. Arnold Arb. 19 (1938) 109. Mem. Am. Acad. Arts. Sci. 18 (1939) 172. (Mem. Gray Herb. 4:172).

Throughout the Philippines in most islands and provinces, Borneo, Java, Sumatra, Malay Peninsula, Siam, Indo-China.

I now accept Presl's specific name as the proper one for this widely distributed species, as did Henderson, for the reason that the oldest binomial involved, *Myrtus lineata* Blume (1826), was invalidated by the earlier *M. lineata* Swartz (1800).

SYZYGIUM LONGIPEDICELLATUM (Merr.) comb. nov.

Eugenia longipedicellata Merr., Manila, Govt. Lab. Publ. 17 (1904) 37.
Eugenia longipedicellata C. B. Rob., Philip. Jour. Sci. 4C (1909) 349; Merr., Enum. 3 (1923) 169.

A very strongly characterized species with long slender peduncles and pedicels originally described from specimens collected at Baler, east coast of Tayabas (now Quezon) Province, Luzon. Now represented by two additional collections from the east coast of Quezon Province, *Bur. Sci. 54324 Ramos* and *Edaño*, and *P. N. H. 4617 Alcasid* and *Edaño*.

SYZYGIUM LONGISSIMUM (Merr.) comb. nov.

Eugenia longissima Merr., Manila, Govt. Lab. Publ. 35 (1906) 50, Enum. 3 (1923) 169.

Previously known only from two collections, *Elmer 6218* from Benguet and *Bur. Sci. 5124 Ramos* from Zambales Province, Luzon. A third collection is *Bur. Sci. 46859 Ramos* and *Edaño* from Isabela Province, Luzon.

SYZYGIUM LONGISTYLUM (Merr.) comb. nov.

Eugenia longistyla Merr., Philip. Jour. Sci. 10C (1915) 220, Enum. 3 (1923) 169.

A species known only from two Cagayan Province, Luzon, collections, *For. Bur. 17910 Barros* (type), and *For. Bur. 24258 Bernardo*.

SYZYGIUM LOROFOLIUM sp. nov.

§ *Jambosae*. Ut videtur arbor parva, glabra, ramis ramulisque teretibus, brunneis vel purpureo-brunneis, ultimis 1 mm. diametro; foliis stricte oppositis, auguste oblongis vel oblongo-lanceolatis, utrinque plus minusve angustatis, obtusis vel obscure obtuse acuminatis, basi acutus vel obtusis 9–15 cm. longis, 2–3 cm. altis, firmiter chartaceis vel subcoriaceis, opacis, oli-

vaceis vel olivaceo-viridibus, subtus plerumque paulo pallidioribus, plus minusve puncticulatis; nervis primariis utrinque 8—10, curvato-adscendentibus, distantibus, arcuato-anastomasantibus, supra leviter impressis, subtus distinctis, elevatis, in venam intramarginalem 2–4 mm. a margine confluentibus, secundariis reticulisque minus conspicuis; petiolo 2–5 mm. longo; inflorescentiis pedunculatis, paucifloris, terminalibus axillaribusque, 5–7 cm. longis, pedunculo sub anthesin 2–4 cm. longo; bracteolis minutis, vix 0.5 mm. longis, deciduis; floribus plerumque 3, circiter 2.5. cm. longis latisque, ut videtur albidis; calycibus infundibuliformibus, deorsum angustatis, tubo 1 cm. longo, ore 1 cm. diametro, lobis 4, late rotundatis, 5–7 mm. latis, circiter 3 mm. longis, plus minusve puncticulatis, persistentibus; petalis ellipticis vel obovatis, rotundatis, circiter 1 cm. longis; filamentis quam petalis longioribus; fructibus turbinatis, 2 cm. diametro.

LUZON, Quezon Province, Guinayangan, *For. Bur. 20889 Escritor,* March-April, 1913 (type in the U. S. National Herbarium); Kabibihan, *Bur. Sci. 13288 Ramos,* February-March, 1911 (flowers immature), herb. Mus. Brit. Samar, without locality, *For. Bur. 21051 Sherfeesee, Cenabre* and *Cortes,* April, 1914, flowers immature, U. S. National Herbarium, "Samar," *Cuming 1903,* herb. Mus. Brit. with mature flowers and fruits.

In its vegetative characters it is somewhat suggestive of *Syzygium polypetalum* (Wall.) comb. nov. (*Eugenia polypetala* Wall. List No. *3616,* (1830); Wight, Ill. Bot. Ind. 2 (1841) 14; *Eugenia angustifolia* Roxb., non Lam.) of India, but is not closely allied to that species.

A species well characterized by its slenderly peduncled, few flowered, mostly terminal (some times lateral) inflorescences, its medium or rather large sized flowers and especially by its narrow, elongated, somewhat strap-shaped leaves. All of the specimens were distributed merely as *Eugenia* sp. The Cuming number is not localized in his list of localities (see Philip. Jour. Sci. 30 (1926) 175), falling in the group of unlocalized numbers between *1858* and *2153.* The label bears merely the number and the locality Samar. As what is manifestly the same species has since been collected in Samar, the indicated locality is probably correct. In some respects the species suggests *Syzygium lancilimbum* (Merr.) Merr., but the inflorescences are totally different while in vegetative characters the two do not conform.

SYZYGIUM LUTEUM (C. B. Rob.) comb. nov.

Eugenia lutea C. B. Rob., Philip. Jour. Sci. 6C (1911) 350; Merr., Enum. 3 (1923) 170.

A species growing along river banks in Quezon Province, Luzon, *For. Bur. 18635 Darling* and *Bur. Sci. 13201 Foxworthy* and *Ramos*. *Bur. Sci. 20784 Escritor* from the same province is a form of this with somewhat smaller leaves than the type.

SYZYGIUM LUZONENSE (Merr.) comb. nov.

Eugenia luzonensis Merr., Manila, Govt. Lab. Publ. 17 (1904) 37, Enum. 3 (1923) 170.

A widely distributed species extending from Cagayan Province, Luzon, to Mindoro, Masbate, Negros, and Mindanao. A recent collection is *P. N. H. 1643 Alcasid* from Laguna Province, Luzon.

SYZYGIUM MACGREGORII (C. B. Rob.) comb. nov.

Eugenia macgregorii C. B. Rob., Philip. Jour. Sci. 4C (1909) 367; Merr., Enum. 3 (1923) 170.

A widely distributed species extending from southern Luzon Samar and Leyte to Palawan and Mindanao. Two recent collections are *Philip. Nat. Herb. 2048, 2052 Quisumbing* from Calicoan Island near Samar. Quezon and Bulacan collections distributed as representing this species are now referred to *Syzygium affine* Merr., supra.

SYZYGIUM MAINITENSE (Elm.) comb. nov.

Eugenia mainitensis Elm., Leafl. Philip. Bot. 4 (1912) 1415; Merr., Enum. 3 (1923) 170.

Eugenia leucocarpa Merr., Philip. Jour. Sci. 11C (1916) 23.

This was previously known from Sorsogon Province, Luzon, and Mindanao. Additional recent collections are *P. N. H. 2699 Sulit* from Sorsogon Province, and *P. N. H. 6428, 6434 Sulit, 5849 Castro* from Samar. It is apparently closely allied to *Syzygium incarnatum* (Elm.) Merr. and Perr.

SYZYGIUM MALACCENSE (Linn.) Merr. and Perr.

Syzygium malaccense (Linn.) Merr. and Perr., Jour. Arnold Arb. 19 (1938) 215; Mem. Am. Acad. Arts Sci. 18 (1939) 154. (Mem. Gray Herb. 4:154), *cum. syn.*

Eugenia malaccensis Linn., Sp. Pl. (1753) 470; Merr., Enum. 3 (1923) 170. *cum. syn.;* Henders, Gard. Bull. Singapore 12 (1949) 46, *fig. 6a.*

Jambosa malaccensis DC., Prodr. 3 (1828) 286.

Widely distributed in the Philippines in cultivation, a prehistoric introduction from Indo-Malaysia; now planted in the tropical parts of both hemispheres.

SYZYGIUM MALAGSAM (Elm.) comb. nov.

Eugenia malagsam Elm., Leafl. Philip. Bot. 4 (1912) 1403; Merr., Enum. 3 (1923) 170.

Definitely known only from the type collection, *Elmer 11838* from Mindanao (Davao), but a recent collection with very young buds from Mount Halcon, Mindoro, *P. N. H. 3261 Edaño*, may belong here. This is apparently closely allied to *S. durum* (Merr.) Merr., but its fruits are nearly globose, not cylindric and more or less elongated.

SYZYGIUM MANANQUIL (Blanco) comb. nov.

Myrtus mananquil Blanco, Fl. Filip. (1837) 431; Merr., Enum. 3 (1923) 171, *cum. syn.*

Eugenia livida Elm., Leafl. Philip. Bot. 7 (1914) 2349.

A very characteristic species extending from northern Luzon to Mindoro, Leyte, and Mindanao.

SYZYGIUM MARTELINOI (Merr.) comb. nov.

Eugenia martelinoi Merr., Philip. Jour. Sci. 18 (1921) 306, Enum., 3 (1923) 171.

A species still known only from the type collection, *Bur. Sci. 35630 Martelino* and *Edaño* from Panay.

SYZYGIUM MEGALANTHUM (C. B. Rob.) comb. nov.

Eugenia megalantha C. B. Rob., Philip. Jour. Sci. 4C (1909) 374; Merr., Enum. 3 (1923) 171.

A species known only from Palawan; two additional recent collections are *P. N. H. 146, 254 Edaño* from Iwahig, Palawan, the type locality.

SYZYGIUM MEGISTOPHYLLUM nom. nov.

Eugenia megalophylla Merr., Philip. Jour. Sci. 27 (1925) 42, Enum. 3 (1923) 171. non *Syzygium megalophyllum* Merr. and Perr. (1939).

Still known only from the type collection, *Loher 13596*, from the Umirey region, Quezon Province, Luzon.

SYZYGIUM MELLIODORUM (C. B. Rob.) comb. nov.

Eugenia melliodora C. B. Rob., Philip. Jour. Sci. 4C (1909) 401; Merr., Enum. 3 (1923) 171.

Central Luzon (Laguna, Quezon) to Mindoro and Leyte. A recent collection is *P. N. H. 6482 Castro* from Polillo.

SYZYGIUM MERRILLII (C. B. Rob.) comb. nov.

Eugenia merrillii C. B. Rob., Philip. Jour. Sci. 4C (1909) 349; Merr., Enum. 3 (1923) 171.

A strongly marked species known only from Palawan and Sibuyan; an additional collection from the type locality in Palawan is *P. N. H. 130 Edaño*.

SYZYGIUM MERRITTIANUM (C. B. Rob.)

Eugenia merritiana C. B. Rob., Philip. Jour. Sci. 4C (1909) 171; Merr., Enum. 3 (1923) 171.
Eugenia lumboy Elm., Leafl. Philip. Bot. 4 (1912) 1431.

LUZON (Pangasinan to Albay), Mindoro, Sibuyan. Additional collections are *Vidal 2782* from Rizal Province, and *Vidal 2799* from Bataan Province, Luzon, both in Herb. Kew.

SYZYGIUM MIMICUM (Merr.) comb. nov.

Eugenia mimica Merr., Philip. Jour. Sci. 1 Suppl. (1906) 112; Merr., Enum. 3 (1923) 172.
Eugenia submimica Elm., Leafl. Philip. Bot. 4 (1912) 1438.

LUZON (Ilocos Norte to Quezon), Mindoro, Palawan, Sibuyan, Leyte, and Mindanao. Additional collections from near the type locality of *Eugenia submimica* Elm., in Palawan are *Ebalo 403* and *P. N. H. 211 Edaño.* Also referable here is *Cuming 958,* Pangasinan Province, Luzon, in herb. British Museum.

SYZYGIUM MINDORENSE (C. B. Rob.) comb. nov.

Eugenia mindorensis C. B. Rob., Philip. Jour. Sci. 4C (1909) 399; Merr., Enum. 3 (1923) 172.

LUZON (Batangas), Mindoro. The Palawan and Banguey records were apparently based on erroneously identified specimens.

SYZYGIUM MIRABILE (Merr.) comb. nov.

Eugenia mirabilis Merr., Philip. Jour. Sci. 20 (1922) 412, Enum. 3 (1923) 172.

MINDANAO (Zamboanga), *Bur. Sci. 36772, 37238, 37347 Ramos* and *Edaño,* cited in the original description. An additional collection is *Zwickey 127* from Lanao Province, Mindanao.

SYZYGIUM MIRANDAE (Merr.) comb. nov.

Eugenia mirandae Merr., Philip. Jour. Sci. 10C (1915) 221, Enum. 3 (1923) 172.

A species still known only from the type collection, *For. Bur. 21687 Miranda,* from Camarines Province, Luzon.

SYZYGIUM MULTINERVE (C. B. Rob.) comb. nov.

Eugenia multinervis C. B. Rob., Philip. Jour. Sci. 4C (1909) 352; Merr., Enum. 3 (1923) 172.

The type is *Cuming 1299* from Cagayan Province, Luzon, collected more than a century ago, and not re-collected in modern times. There are specimens in the Kew and British Museum herbaria which I have examined, the former sterile, the latter with the cauline inflorescences from small tubercles a striking characteristic of the species.

SYZYGIUM MULTIPUNCTICULATUM sp. nov.

Arbor glabra, 7–8 m. alta, ramis ramulisque pallidis, teretibus, ultimis circiter 1.5 mm. diametro; foliis numerosis, ellipticis vel elliptico-obovatis, 3–4 cm. longis, 1.5–2 cm. latis, rotundatis vel obtusis, basi acutis, coriaceis, in sicco supra brunneis, subtus pallidioribus, leviter nitidis, nervis numerosissimis, paralellis, obscuris, inter se circiter 1 mm. distantibus, supra subdense minute scrobiculato-puncticulatis, subtus glanduloso-puncticulatis; petiolo 4–6 mm. longo; inflorescentiis terminalibus, fasciculatis, plerumque 4–5, omnibus pedunculatis, opposite vel subverticillatim ramosis, ramulis plus minusve angulatis vel sulcatis, primariis plerumque 1.5 cm. longis, secundariis 5–10 mm. longis, trinis, pedunculo 6–10 cm. longo; floribus parvis, circiter 8 mm. longis in ramulis ultimis in triadibus dispositis, sessilibus, bracteis bracteolisque ut videtur minutis, deciduis; calycibus circiter 4 mm. longis, infundibuliformibus, deorsum angustatis, sursum 3 mm. diametro, lobis 4, latissime rotundatis, circiter 0.5 mm. longis et 1.5 mm. latis; petalis imbricatis, adhaerentibus, calyptram 3 mm. diametro formantibus.

SAMAR, Loquilocon, near Wright, *Philip. Nat. Herb. 6084 M. D. Sulit*, April 10, 1948, in forests, alt. 150 m., flowers white, fragrant, with the local name 'kalogkog'.

A species manifestly allied to *Syzygium mainitense* (Elm.) Merr. (*Eugenia mainitensis* Elm.; *E. leucocarpa* Merr.), but with smaller, more obscurely nerved leaves which are conspicuously pitted-puncticulate on the upper surfaces, and glandular-puncticulate beneath. Another recent collection, *Philip. Nat. Herb. 2699 M. D. Sulit*, from Mount Bulusan, Sorsogon Province, Luzon, its flowers very immature, has similarly small leaves, but they are more prominently nerved, and the nerves are more ascending. This for the present I place as a form of Elmer's species.

SYZYGIUM NITIDUM Benth.

Syzygium nitidum Benth., Hook. Lond. Jour. Bot. 2 (1843) 221.
Eugenia benthamii A. Gray, Bot. Wikes U. S. Explor. Exped. (1854) 520; Merr., Enum. 3 (1923) 159.

Widely distributed in Luzon, extending to Mindoro and Mangsi Island, near Borneo; type from Tobie [Jobi] Island, Geelvink Bay, New Guinea.

Perhaps more than one species is included in the rather numerous Philippine collections that have been distributed as representing *Eugenia benthamii* A. Gray, the valid name in

Eugenia because of the earlier *Eugenia nitida* Vell.; in *Syzygium* Bentham's original name is valid. Presumably the type from Jobi Island was a low altitude plant as was certainly the Mangsi collection of the U. S. Wilkes Exploring Expedition that Gray considered. I think these two collections undoubtedly represent a single species but it is 40 years since I compared the two at Kew, and at that time I was not very familiar with the differential specific characters in this difficult genus. It may be that some of the inland Philippine collections from medium and even fairly high altitudes represent a different species.

SYZYGIUM OBLANCEOLATUM (C. B. Rob.) comb. nov.

Eugenia oblanceolata C. B. Rob., Philip. Jour. Sci. 4C (1909) 400; Merr., Enum. 3 (1923) 173.

LUZON (Sorsogon) to Biliran, Samar and Mindanao (Davao), *Cuming 1676, Williams 2862, Elmer 11627, 16064, Bur. Sci. 18830 McGregor.*

SYZYGIUM OBLIQUINERVIUM (Elm.) comb. nov.

Eugenia obliquinervia Elm., Leafl. Philip. Bot. 10 (1939) 3768, descr. angl.

Arbor glabra, circiter 18 m. alta, ramis ramulisque teretibus, pallidis, ultimis circiter 1.5 mm. diametro; foliis subcoriaceis, oppositis, distincte petiolatis (petiolo 1.5 cm. longo), oblongis, oblongo-oblanceolatis vel subellipticis, 8–13 cm. longis, 3–5 cm. latis, subacutis vel breviter obtuse acuminatis, basi acutis, haud puncticulatis, sicco supra atro-olivaceis, nitidis, subtus pallide brunneis; nervis primariis utrinque 4–6, subadscendentibus, subtus distinctis, elevatis, circiter ad marginem arcuato-anastomosantibus, reticulis laxis; inflorescentiis ut videtur termianlibus fide Elmer sub fructu 2–4 cm. longis (haud visis), floribus ignotis; fructibus (sicco) anguste ellipsoideis, circiter 3 x 1.8 (in vivo 3–4 x 2.5 cm. fide Elmer), rectis vel obscure inaequilateralibus, subverruculosis, obscurissime longitudinaliter striatulis, calycis tubo distincte producto 4–5 mm. diametro truncato.

The only known collection is *Elmer 16117* from Mount Bulusan, Sorsogon Province, Luzon. I do not know to which of the numerous described species it is allied, for to determine this, apparently inflorescences and flowers are essential. Perhaps its most striking character is its prominently nerved leaves, the few, distant, primary nerves distinctly ascending. The Arnold Arboretum specimen has two detached fruits in a packet, and this specimen I make the actual type as far as the above diag-

nosis is concerned; the Gray Herbarium sheet consists of a leafy branch only. But for the fact that this has been named and described by Elmer, in English, I should not have considered it until better material becomes available. It probably belongs in sect. *Jambosa.*

SYZYGIUM OLEINUM Wall.

Syzygium oleinum Wall. ex Wight, Ill. 2 (1841) 15, *nom.* in *syn.*, et Walp., Repert. 2 (1843) 178, *nom.*

Eugenia oleina Wight, Ill. 2 (1841) 15, *nom.*; Craib Fl. Siam., Merr., Enum. 1 (1931) 653, *nom.*; Henders., Gard. Bull. Singapore 12 (1949) 150, *fig.* 29 *e-f*, *cum. syn.*

Eugenia myrtifolia Roxb., Hort. Bengal. (1814) 37, *nom.*; Fl. Ind. ed. 2 (1832) 490, *descr.*, non Salisb. (1796), nec Sims (1821), nec Cambess. (1829).

Syzygium myrtifolium DC., Prodr. 3 (1828) 261, *nom.*; Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 182. (Mem. Gray Herb. 4:182).

Syzygium campanulatum Korth., Nederl. Kruidk. Arch. 1 (1847) 203; Walp. Ann. 2 (1851–52) 630.

Syzygium campanellum Miq., Fl. Ind. Bat. 1[1] (1855) 451.

Eugenia acuminatissima var. *parva* Merr., Philip. Jour. Sci. 1 Suppl. (1906) 104.

Eugenia parva C. B. Rob., Philip. Jour. Sci. 4C (1909) 341; Merr., Enum. 3 (1923) 173.

Eugenia sinubanensis Elm., Leafl. Philip. Bot. 4 (1912) 1424.

Syzygium sinubanense Diels, Bot. Jahrb. 57 (1922) 411, *nom.* in nota.

This is a widely distributed species in the Philippines, and as interpreted by Henderson, it extends from Burma and Siam to the Malay Peninsula, Anamba Islands, Sumatra, and Borneo. One might argue against the propriety of accepting of the specific name that Wallich originated, for until Henderson considered the species no description seems to have been published under *Eugenia oleina* (Wall.) Wight. Wight's entry for *Eugenia myrtifolia* Roxb. and *E. oleina* Wight is:

> "34 *. E. (*S.*) *Myrtifolia* Roxb. Fl. Ind. 2, P. 490). 35 *. E. (*S.*) *Oleina* (R. W.-Syzygium oleinum Wall.) These two, if distinct, are so like each other that I cannot see by what characters they can be defined, I look upon them, judging from specimens only, as identical."

Wight gave no descriptions, but in the above statement he did, as Henderson noted, associate *Syzygium oleinum* Wall., which had not been described, with *Eugenia myrtifolia* Roxb. which had been described in 1832 from material cultivated at Calcutta originating in Sumatra; yet Roxburgh's specific name was invalid in *Eugenia* when published. De Candolle's transfer of it to *Syzygium* in 1828 is also a *nomen nudum* as he gave no description, merely citing Roxburgh's *nomen nudum* of 1814 as the source of his binomial. If the above synonymy be correct, as I think it is, *Syzygium campanulatum* Korth., type from Sumatra, is perhaps the oldest name in *Syzygium* with a clear record. *Syzygium campanellum* Miq. was based on a specimen from a tree cultivated at the Botanical Garden, Buitenzorg, Java, and it may rather safely be assumed that this was the earlier *S. campanulatum* Korth. which Miquel did not account for. There is an excellent specimen in the Gray Herbarium under Korthals' binomial indicated as "cult. in Hort. Bogor. Java 1851." This specimen very closely matches another sheet in the Gray Herbarium labelled *Syzygium myrtifolium* DC., taken from the cultivated tree in the Calcutta Botanical Garden which was the basis of the original Roxburgh name.

SYZYGIUM PALAWANENSE (C. B. Rob.) Merr. and Perr.

Syzygium palawanense (C. B. Rob.) Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 177. (Mem. Gray Herb. 4:177).
Eugenia palawanensis C. B. Rob., Philip. Jour. Sci. 4C (1909) 377; Merr., Enum. 3 (1923) 173.

The type and only known Philippine collection is *For. Bur. 3503 Curran* from Palawan. Six Bornean collections represent the same species.

SYZYGIUM PALLIDUM Merr.

Syzygium pallidum Merr., Manila, Govt. Lab. Publ. 17 (1906) 17.
Eugenia perpallida Merr., Philip. Jour. Sci. 1 Suppl. (1906) 106.
Eugenia pacifica Elm., ex Merr., Enum. 3 (1923) 174, *nom.* in obs.; Elm. Leafl. Philip. Bot. 10 (1939) 3808, *nom.* "*E. pacifica* Elm. is *E. perpallida* Merr."

A widely distributed species extending from northern Luzon to Mindanao. The original specific name was invalid in *Eugenia*, this explaining the use of the binomial *Eugenia perpallida* Merr. *For. Bur. 29832 Marquez* from Negros (distributed as *E. parva* Merr.), *For. Bur. 23202 Alejandro* from Cagayan Province, Luzon, *For. Bur. 26646* Velasco from Cagayan Island, *For. Bur. 25631* Cailipan from Quezon Province, Luzon, *For. Bur. 18910 Miranda* from Basilan, *For. Bur. 29874 Canilao* from Negros, all distributed as *Eugenia* sp., and *Elmer 12548* from Sibuyan, distributed under an unpublished specific name derived from the name of the town of Magallanes, all represent this species.

SYZYGIUM PANAYENSE (Merr.) comb. nov.

Eugenia panayensis Merr., Philip. Jour. Sci. 18 (1921) 292, Enum. 3 (1923) 173.

A species still known only from the type collection, *Bur. Sci. 32470 McGregor* from Panay.

SYZYGIUM PANDURIFORME (Elm.) comb. nov.

Eugenia panduriformis Elm., Leafl. Philip. Bot. 4 (1912) 1412; Merr., Enum. 3 (1923) 173; Hulth. and Lam, Blumea 5 (1949) 218.

A species known from three Mindanao collections, Davao, *Elmer 11246* and Bukidnon, *Bur. Sci. 38613 Ramos* and *Edaño;* a recent one is *P. N. H. 10144 Sulit* also from Bukidnon. Also in the Sangi Islands, north of Celebes.

SYZYGIUM PASCASIOII (Merr.) comb. nov.

Eugenia pascasioii Merr., Philip. Jour. Sci. 18 (1921) 307, Enum. 3 (1923) 173.

Known only from the type collection from Bucas Grande, *Bur. Sci. 35057 Ramos* and *Pascasio.*

SYZYGIUM PAUCIVENIUM (C. B. Rob.) comb. nov.

Eugenia paucivenia C. B. Rob., Philip. Jour. Sci. 4C (1909) 382; Merr., Enum. 3 (1923) 174.

CAMIGUIN ISLAND (Babuyan group) and Luzon (Ilocos Norte). Other collections are *Vidal 2807* from Rizal Province, Luzon, Herb. Kew., and *Bur. Sci. 79309, 79329 Edaño* from Camiguin Island, Babuyan group, distributed from Manila as "paucinervia."

SYZYGIUM PENASII (Merr.) comb. nov.

Eugenia penasii Merr., Philip. Jour. Sci. 18 (1921) 293, Enum. 3 (1923) 178.

Known only from the type collection Calayan Island (Babuyan group between Formosa and Luzon) *For. Bur. 26703 Peñas.*

SYZYGIUM PEREGRINUM (Blume) Merr. and Perr.

Syzygium peregrinum (Blume) Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 154. (Mem. Gray Herb. 4:154).

Jambosa peregrina Blume, Mus. Bot. Lugd. Bat. 1 (1849) 92.

Eugenia tawanensis Merr., Univ. Calif. Publ. Bot. 15 (1929) 220.

SULU ARCHIPELAGO, Bengas Island, *Bur. Sci. 36317 Yates,* Oct. 1919, distributed as *Eugenia tula* Merr. Mindanao, Zamboanga Province near Kabaslan, *Ebalo 786,* Dec. 13, 1940. New to the Philippine flora. Borneo.

SYZYGIUM PHANEROPHLEBIUM (C. B. Rob.) comb. nov.

Eugenia phanerophlebia C. B. Rob., Philip. Jour. Sci. 4C (1909) 353; Merr., Enum. 3 (1823) 174.

A widely distributed species extending from northern Luzon to Mindanao, *Bur. Sci. 15340 Ramos* from Leyte and *Bur. Sci. 16622 Ramos* from Laguna Province, both distributed as *Eugenia* sp. belong here.

SYZYGIUM PHILIPPINENSE (C. B. Rob.)

Eugenia philippinensis C. B. Rob., Philip. Jour. Sci. 4C (1909) 378; Merr., Enum. 3 (1923) 174.

Northern Luzon to Samar and Leyte, *Merrill 2054*, *For. Bur. 12761 Rosenbluth*, etc.

SYZYGIUM POLISENSE sp. nov.

Arbor glabra, circiter 6 m. alta, ramis ramulisque rigidis, teretibus, ultimis brunneis vel atris, ramis pallidis; foliis crasse coriaceis, rigidis, confertis, ellipticis, utrinque late rotundatis vel basi late acutis, 3.5–7 cm. longis, 2.5–4.5 cm. latis, supra olivaceis, nitidis, subtus pallidioribus, haud puncticulatis, opacis vel obscure nitidis, margine subcartilagineis, leviter revolutis; nervis primariis utrinque circiter 8, inter se 4–8 mm. distantibus, rectis vel leviter curvatis, utrinque elevatis, in venam distinctam intramarginalem 3–6 mm. a margine confluentibus, secundariis paucis vel nulis sed reticulis utrinque distinctis; petiolo crasso, 1–2 mm. longo; inflorescentiis stricte terminalibus, 3–4 cm. longis latisque, pedunculis semper 3, circiter 2 cm. longis; floribus in ramulis ultimis in triadibus confertis, sessilibus, inter minores, sub anthesin 8 mm. longis latisque; bracteis triangulari-ovatis, carinatis, acutis, subcoriaceis, quam bracteolis paullo majoribus: calycibus subinfundibuliformibus, tubo circiter 4 mm. longo, ore 4 mm. diam., lobis brevibus, late rotundatis; petalis valde imbricatis, calyptratim deciduis; stylo 5 mm. longo.

LUZON, Mountain Province (Ifugao), Mount Polis, *Phil. Nat. Herb. 7813 Celestino*, (type), May 11, 1948, in the mossy forest near the summit altitude about 2,040 m. Same locality, *Bur. Sci. 37625 Ramos* and *Edaño*, February, 1920, distributed as representing *Eugenia alvarezii* C. B. Rob. to which it is not closely allied. It is characterized by its elliptic, very coriaceous, rounded and rather prominently nerved, crowded leaves, and its small crowded flowers. In some respects it suggests *Syzygium paucivenium* (C. B. Rob.) Merr., but is not closely allied to that species.

SYZYGIUM POLYANTHUM (Wight) Walp.

Syzygium polyanthum (Wight) Walp., Repert. 2 (1843) 180; Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 155. (Mem. Gray Herb. 4:155).

Eugenia polyantha Wight, Ill. 2 (1841) 17; Henders., Gard. Bull. Singapore 12 (1949) 211, *fig. 40a*.

Eugenia balsamea sensu Ridl., Fl. Malay Penin. 1 (1922) 754, non Wight.

Eugenia junghuhniana Miq., Fl. Ind. Bat. 1^1 (1855) 441.

Eugenia nitida Duthie, in Hook. f. Fl. Brit. Ind. 2 (1878) 496, non Vell.

Eugenia atropunctata C. B. Rob., Philip. Jour. Sci. 4C (1909) 385; Merr., Enum. 3 (1923) 158. *syn. nov.*

Eugenia lambii Elm., Leafl. Philip. Bot. 4 (1912) 1430; Merr., Enum. 3 (1923) 168, *syn. nov.*

Eugenia holmani Elm., Leafl. Philip. Bot. 7 (1914) 2354, *syn. nov.*

Northern Luzon to Palawan and Mindanao, and outside of the Philippines, Burma, Siam and Indo-China through the Malay Peninsula to Sumatra, Java and Borneo.

To the synonymy as given by Henderson, Gard. Bull. Singapore 12 (1949) 211, I now add three Philippine binomials, *Eugenia atropunctata* C. B. Rob. (1908), *E. holmani* Elm. (1914), and *Eugenia lambii* Elm. (1912). A rather critical examination of numerous collections, both from the Philippines and from the extra-Philippine range of the species indicate no characters by which *Eugenia atropunctata* C. B. Rob. may be maintained. I have before me the British Museum sheet *of Cuming* 1308, the type collection of Robinson's species. *Vidal 2809, 2817* from Albay Province (herb. Kew.) belong here, as does *For. Bur. 21793 Barros* from Cagayan Province, Luzon, distributed as *Eugenia* sp. By error the type collection of *Eugenia holmani* Elm. (*Elmer 13356*) was distributed as *E. bakeri* Elm.; the latter is a synonyms of *Syzygium astronioides* (C. B. Rob.) Merr. Were Gagnepain correct in reducing *Jambolifera rezinosa* Lour. (1790) to *Eugenia polyanthum* Walp., then Loureiro's specific name would be the oldest one for this much named species. However, the plant that Loureiro described is clearly the rutaceous *Acronychia pedunculata* (Linn.) Miq.; see Merrill, Trans. Am. Philos. Soc. II. 24 2 (1935) 220. Other synonyms of *Syzygium polyanthum* Walp. are *Myrtus cymosa* Blume (1826), non Spreng., *Syzygium cymosum* Korth. (1847), non DC., *Eugenia microbotrya* Miq. (1850), *Syzygium confusum* Blume (1850), *Eugenia pamatensis* Miq. (1850), *Syzygium micranthum* Blume (1850), *Eugenia lucidula* Miq. (1850), and *Eugenia resinosa* Gagnep. (1918).

SYZYGIUM POLYCEPHALOIDES (C. B. Rob.) comb. nov.

Eugenia polycephaloides C. B. Rob., Philip. Jour. Sci. 4C (1909) 378; Merr., Enum. 3 (1923) 174.

Northern Luzon (Cagayan Province) to Samar, Leyte, and Mindanao, *Elmer 8233, 9233, 15794, Bur. Sci. 17578 Ramos*, etc.

SYZYGIUM PULGARENSE (C. B. Rob.) comb. nov.

Eugenia pulgarensis C. B. Rob., Philip. Jour. Sci. 4C (1909) 174; Merr., Enum. 3 (1923) 174.

A species known only from the type collection, *For. Bur. 3382 Curran*, from Palawan.

SYZYGIUM PURPURIFLORUM (Elm.) comb. nov.

Eugenia purpuriflora Elm., Leafl. Philip. Bot. 4 (1912) 1482; Merr., Enum. 3 (1923) 175.

Known only from Palawan from the type collections *Elmer 13117*, *13233*, and *For. Bur. 21486 Fernandez.*

SYZYGIUM RAMOSII (C. B. Rob.) comb. nov.

Eugenia ramosii C. B. Rob., Philip. Jour. Sci. 4C (1909) 349; Merr., Enum. 3 (1923) 175.

A species known only from the type collection *Bur. Sci. 8030 Ramos*, from Isabela Province, Luzon.

SYZYGIUM RIGIDIFOLIUM sp. nov.

§ *Jambosae.* Ut videtur arbor parva, glabra, ramis ramulisque teretibus, rigidis, pallidis vel pallide brunneis, ultimis 2 mm. diametro; foliis stricte oppositis, sessilibus vel brevissime petiolatis, crasse coriaceis, rigidis, oblongo-ellipticis, 5–10 cm. longis, 2.5–5.5 cm. latis, apice rotundatis vel breviter acuminatis, basi late rotundatis vel obscure subcordatis, supra brunneo-olivaceis vel olivaceis, opacis, minute scrobiculato-puncticulatis, subtus pallidioribus, brunneis, obscure pustulatis vel puncticulatis, margine leviter revolutis vel planis; nervis primariis utrinque 7–8, rectis vel leviter curvatis, subadscendentibus, supra obscuris, subtus subelevatis, distinctis, inter se 6–14 mm. distantibus, in venam intramarginalem 2–3 mm. a margine confluentibus, secundariis paucis, inconspicuis, reticulis obsoletis vel subobsoletis; petiolo crasso, vix 2 mm. longo vel nullo; inflorescentiis terminalibus vel interdum axillaribus, brevissimis, paucifloris 1–3–floris, brevissime peduncalatis vel sessilibus; floribus inter majores, sessilibus vel brevissime pedicellatis, ebractolatis; calycis tubo fere 2 cm. longo sursum 1.5 cm. diametro, deorsum leviter angustato, brunneo, lobis 4, coriaceis, reniformibus, ad 5 mm. longis et 8 mm. latis; petalis maturis non visis; filamentis circitir 1 cm. longis; stylo exserto, 2 cm. longo.

LUZON, Isabela Province, Mt. Moises, *Clemens 16945*, April, 1926, type herb. Arnold Arboretum, isotypes in the Kew and the United States National herbaria.

Apparently a species belonging in the group with *Syzygium subrotundifolium* (C. B. Rob.) Merr. but with very much smaller leaves. It is characterized by its vegetative features, especially in its practically sessile leaves, its very short, few-flowered inflorescences, and its large flowers, apparently only one flower in an inflorescence opening at a time.

SYZYGIUM RIZALENSE (Merr.) comb. nov.

Eugenia rizalensis Merr., Philip. Jour. Sci. **18** (1921) 302, Enum., **3** (1923) 175.

A species known only from the type collection, *Bur. Sci. 8030 Ramos,* from Rizal Province, Luzon.

SYZYGIUM ROBERTII Merr.

Syzygium robertii Merr., Philip. Jour. Sci. **1** Suppl. (1906) 106, Enum. **3** (1923) 176.
Eugenia succulenta Elm., Leafl. Philip. Bot. **4** (1909) 1442.

LUZON (Benguet to Quezon) Lubang and Sibuyan. Additional collections are *Bur. Sci. 23480 Ramos* from Sorsogon Province, *P. N. H. 8371 Sulit, For. Bur. 23793 Mabesa,* from Laguna Province, and *Loher 7259* from Rizal Province, Luzon.

SYZYGIUM ROBINSONII (Elm.) comb. nov.

Eugenia robinsonii Elm., Leafl. Philip. Bot. **2** (1909) 583; Merr., Enum. **3** (1923) 175.

A species known only from the type collection, *Elmer 10050,* from Negros.

SYZYGIUM ROLFEI sp. nov.

Ut videtur arbor parva, glabra, ramis ramulisque teretibus, pallidis, ultimis 1.2–2 mm. diametro; foliis praesertim subtus minute sed subdense glanduloso-puncticulatis, glandulis haud impressis, oblongo-ellipticis, 4–6 cm. longis, 2–5 cm. latis, coriaceis, opacis, supra viridibus vel olivaceo-viridibus, subtus pallidioribus, apice breviter acuminatis, basi decurrente cuneatis vel acuminatis; nervis primariis utrinque circiter 10, haud perspicuis, quam secundariis magis numerosis paullo distinctioribus, in venam intramarginalem 1.5–2 mm. a margine confluentibus; petiolo circiter 1 cm. longo; inflorescentiis lateralibus, in ramis plerumque infra foliis, 3–4 cm. longis, pedunculatis, pedunculo 1–1.5 cm longo, ramis paucis, patulis, circiter 1 cm. longis; floribus inter minores, in ramulis ultimis in triadibus dispositis, sessilibus, ramulis ultimis vix 5 mm. longis; circiter 8 mm. longis, bracteis obscuris, haud 1 mm. longis; calycis tubo 3–4 mm. diametro, cupulato, 2.5–3 mm. longo, deorsum plus minusve angustato, margine undulato-crenato, lobis 4, late rotundatis, vix 1 mm. longis; petalis imbricatis, calyptratim deciduis; filamentis 5–6 mm. longis; stylo 4–5 mm. longo.

PANAY, Leon, *Vidal 2768,* with the local name baguilumboy, type in herb. Kew.

This species is dedicated to Mr. R. A. Rolfe, who, as a young assistant at Kew, assisted Vidal in identifying the latter's large collection of Philippine plants; these Vidal collections were accessioned at Kew in March, 1886. It is well characterized by its rather densely nerved leaves although the fewer primary ones are reasonably well differentiated from the more numerous and roughly parallel secondary ones, but especially by its peduncled, relatively short inflorescences borne on the branches below the leaves.

SYZYGIUM ROSENBLUTHII (C. B. Rob.) comb. nov.

Eugenia rosenbluthii C. B. Rob., Philip. Jour. Sci. 4C (1909) 384; Merr., Enum. 3 (1923) 175.
Eugenia burebidensis Elm., Leafl. Philip. Bot. 4 (1912) 1436.

Known by three collections only, *For. Bur. 16890 Rosenbluth* from Leyte, and *Elmer 12259, 13753* from Mindanao (Davao and Agusan). It is suspected that too many species have been proposed in this particular group. *Eugenia rosenbluthii* C. B. Rob., the type collection not now available to me, should be compared with *Syzygium attenuatum* (Miq.) Merr. and Perr. as Airy Shaw has suggested. It is, however, possible that I erred in reducing *Eugenia burebidensis* Elm. to Robinson's species.

SYZYGIUM ROSEOMARGINATUM (C. B. Rob.) Merr. and Perr.

Syzygium roseomarginatum (C. B. Rob.) Merr. and Perr., Mem. Am. Acad. Arts Sci. 18 (1939) 191. (Mem. Gray Herb. 4:191).
Eugenia roseomarginata C. B. Rob., Philip. Jour. Sci. 4C (1909) 390; Merr., Enum. 3 (1923) 175.

A Luzon species extending from Ilocos Norte to Laguna Province; also in Borneo. *Bur. Sci. 22435 Ramos*, a fruiting specimen from Pampanga Province, apparently belongs here.

SYZYGIUM RUBROPURPUREUM (C. B. Rob.) Airy Shaw

Syzygium rubropurpureum (C. B. Rob.) Airy Shaw, Kew Bull. (1949) 118.
Eugenia rubropurpurea C. B. Rob., Philip. Jour. Sci. 4C (1909) 358; Merr., Enum. 3 (1923) 175.

Known from seven collections from the Zamboanga Peninsula in Mindanao and the neighboring island of Basilan, *Bur. Sci. 36766 Ramos* and *Edaño*, etc.

SYZYGIUM RUBROVENIUM (C. B. Rob.) comb. nov.

Eugenia rubrovenia C. B. Rob., Philip. Jour. Sci. 4C (1909) 358, Enum. 3 (1923) 175.
Eugenia agusanensis Elm., Leafl. Philip. Bot. 7 (1914) 2357.

A species limited to Mindanao, three collections only, *Clemens 973,990*, and *Elmer 14118* from Lanao and Agusan.

SYZYGIUM SAMARANGENSE (Blume) Merr. and Perr.

Syzygium samarangense (Blume) Merr. and Perr., Jour. Arnold Arb. 19 (1938) 115, 216; Mem. Am. Acad. Arts Sci. 18 (1939) 167. (Mem. Gray Herb. 4:167).

Myrtus samarangensis Blume, Bijdr. (1826) 1048.

Eugenia javanica Lam., Encycl. 3 (1789) 200; Merr., Enum. 3 (1923) 168, *cum. syn.*; Henders. Gard. Bull. Singapore 12 (1949) 74, *fig. 14b*, non *Syzygium javanicum* Miq., Fl. Ind. Bat. 1^1 (1855) 461.

Widely scattered in cultivation in the Philippines; of prehistoric introduction from Malaya. Malay Peninsula and Archipelago.

SYZYGIUM SANTOSII (Merr.) comb. nov.

Eugenia santosii Merr., Philip. Jour. Sci. 18 (1921) 294, Enum. 3 (1923) 176.

A species still known only from the higher mountains of Benguet Province, Luzon. Recent collections from Mount Pulog and Mount Pauai are *P. N. H. 4341 Celestino* and *7512, 7581 Sulit.*

SYZYGIUM SESSILILIMBUM (Merr.) comb. nov.

Eugenia sessililimba Merr., Philip. Jour. Sci. 18 (1921) 296, Enum. 3 (1923) 177.

A species still known only from the type collection, *Bur. Sci. 33242 Ramos* from Ilocos Norte Province, Luzon.

SYZYGIUM SIDERICOLUM (Merr.)

Eugenia similis Merr., Philip. Jour. Sci. 1 Suppl. (1906) 106, Enum. 3 (1923) 177.

A species still known only from the original two collections, *Bur. Sci. 34722, 34521 Ramos* and *Pascasio* from Surigao Province, Mindanao.

SYZYGIUM SIMILE (Merr.) comb. nov.

Eugenia similis Merr., Philip. Jour. Sci. 1 Suppl. (1906) 106, Enum. 3 (1923) 177.

Calyptranthes ramiflora Blanco, Fl. Filip. (1837) 420, non *Syzygium ramiflorum* Airy Shaw (1949).

A species of wide Philippine distribution extending from Ilocos Norte Province in Luzon to Mindanao.

SYZYGIUM SPECIOSISSIMUM (C. B. Rob.) comb. nov.

Eugenia speciosissima C. B. Rob., Philip. Jour. Sci. 4C (1908) 348; Merr., Enum. 3 (1923) 177.

A species known only from high altitudes in Benguet Province, Luzon, *For. Bur. 10865 Curran, 14193 Merritt.*

SYZYGIUM SQUAMIFERUM (C. B. Rob.) comb. nov.

Eugenia squamifera C. B. Rob., Philip. Jour. Sci. 4C (1909) 378; Merr., Enum. 3 (1923) 177.

A species still known only from the type collection, *For. Bur. 8243 Curran* and *Merrit*, from Zambales Province, Luzon.

SYZYGIUM STRIATULUM (C. B. Rob.) comb. nov.

Eugenia striatula C. B. Rob., Philip. Jour. Sci. 4C (1909) 397; Merr., Enum. 3 (1923) 177.

Eugenia neei Merr., Philip. Jour. Sci. 18 (1921) 301, Enum. 3 (1923) 172, *syn. nov.*

A Luzon species known from a number of collections from Zambales and Rizal provinces, including *Bur. Sci. 27156 Ramos*, type of *Eugenia neei* Merr. from Ilocos Norte Province, and *Bur. Sci. 48665 Edaño* from Rizal Province erroneously distributed as *Eugenia grisea* C. B. Rob. In describing *Eugenia neei* I erroneously placed it in the alliance with *Eugenia clavellata* Merr. *Vidal 1409*, Ilocos Norte, *Vidal 1412*, Zambales and *Loher 7267* (all herb. Kew.) represent this species.

SYZYGIUM SUBCAUDATUM (Merr.) comb. nov.

Eugenia subcaudata Merr., Philip. Jour. Sci. 11C (1916) 21.

Eugenia myrtillus sensu Merr., Enum. 3 (1923) 172, p.p., non Stapf.

The type of this was *Bur. Sci. 23324 Ramos* from Mount Kililibong, Sorsogon Province, Luzon; *Merrill Philip. Pl. 1796* (erroneously distributed as *Eugenia acrophila* C. B. Rob.) represents the same species. A more recent collection is *P. N. H. 7961 Sulit* from Mt. Nañgaoto, Mountain Province, Luzon, February, 1948, while *Loher 5102* (herb. Kew) from Benguet represents the same species. In my Enumeration 3 (1923) 172, I reduced this and *Eugenia ugoensis* C. B. Rob. to *Eugenia myrtillus* Stapf of Borneo, but with six individual collections from Mount Kinabalu, the type locality, before me, I am convinced that this was an error. It is closely allied to *Syzygium ugoense* (C. B. Rob.) Airy Shaw.

SYZYGIUM SUBFALCATUM (C. B. Rob.) comb. nov.

Eugenia subfalcata C. B. Rob., Philip. Jour. Sci. 4C (1909) 382; Merr., Enum. 3 (1923) 177.

A species known only from the type collection *Cuming 1049*, probably from Zambales Province, Luzon. The British Museum specimen of this collection is before me. If the locality is correct, as is probably the case, it is interesting to note that this apparently very local species occurs on a mountain range within sight of the City of Manila.

SYZYGIUM SUBFOETIDUM (C. B. Rob.) comb. nov.

Eugenia subfoetida C. B. Rob., Philip. Jour. Sci. 4C (1909) 360; Merr., Enum. 3 (1923) 178.

The type is *Bur. Sci. 685 Foxworthy* from Mount Victoria, Palawan. The species is otherwise known only from the recently collected *P. N. H. 152 Edaño* from Mount Mantalingahan, Brooke's Point, Palawan.

SYZYGIUM SUBROTUNDIFOLIUM (C. B. Rob.) comb. nov.

Eugenia subrotundifolia C. B. Rob., Philip. Jour. Sci. 4C (1909) 362; Merr., Enum. 3 (1923) 178.

BATAN ISLANDS and northern Luzon to Sorsogon and Polillo.

SYZYGIUM SUBSESSILE (C. B. Rob.) comb. nov.

Eugenia subsessilis C. B. Rob., Philip. Jour. Sci. 4C (1909) 360; Merr., Enum. 3 (1923) 178.

A species known from Negros, Mindanao, and Basilan, *Williams 2748, Bur. Sci. 15872 Fenix*, etc.

SYZYGIUM SUBSESSILIFLORUM (Merr.) comb. nov.

Eugenia subsessiliflora Merr., Philip. Jour. Sci. 10C (1915) 216, Enum., 3 (1923) 178.

Represented by several collections from Samar, Leyte, and Negros, *Merrill Philip. Pl. 1679, Wenzel 942, For. Bur. 23658* Roque.

SYZYGIUM SULCISTYLUM (C. B. Rob.) comb. nov.

Eugenia sulcistyla C. B. Rob., Philip. Jour. Sci. 4C (1909) 368; Merr., Enum. 3 (1923) 178.

Represented by two collections only from Abra and Benguet, *For. Bur. 15873 Bacani, 14551 Darling.* I suspect that *Bur. Sci. 28051 Fenix* from Apayao Subprovince, northern Luzon, is a narrow leaved form of this species.

SYZYGIUM SULITII sp. nov.

Arbor glabra, circiter 5 m. alta, ramis ramulisque pallidis, teretibus, rigidis, ultimis circiter 1.5 mm. diametro; foliis numerosis, confertis crasse coriaceis, obovatis vel obovato-ellipticis, 2–4 cm. longis, 1.5–2.5 cm. latis, breviter (2–5 mm.) petiolatis, apice late rotundatis, basi acutis, margine cartilagineis, supra olivaceis, obscure nitidis, minute scrobiculato-puncticulatis, subtus pallide brunneis, plus minusve punctatis, nervis utrinque numerosis, subaequalibus, parallelis, patulis, inter se haud 1 mm. distantibus; inflorescentiis stricte terminalibus, confertis, 1–2 cm. longis, breviter (5 mm.) pedunculatis vel sessilibus et e basi ramosis, 1–2 cm. diametro, bracteis oblongis, obtusis, coriaceis, 4 mm. longis, bracteolis paullo minoribus; floribus in ramulis lateralibus plerumque 1-floris, in terminalibus plerumque in triadabus dispositis, sessilibus vel breviter crasse pedicellatis, calycis tubo circiter 3 mm. longo, deorsum angustato, plus minusve rugoso, truncato, limbo truncato vel obscure late crenato, circiter 3.5 mm. diametro; petalis 4, suborbicularis, circiter 3 mm. diametro, valde inbricatis, plus minusve adhaerens, calyptratim deciduis; filamentis numerosis, ad 3 mm. longis, inflexis; stylo circiter 1.5 mm. longo.

LUZON. Mountain Province (Benguet), Mount Nañgaoto, *Philip. Nat. Herb. 7766 M. D. Sulit,* Feb. 19, 1948, in the dwarf forest at the summit, altitude about 2,700 m.

A species that in some characters suggests the Bornean *Syzygium ampullarium* (Stapf) Merr. and Perr., but there is no indication that the fruits of this new species are ampulliform. Among the Philippine species it is perhaps most closely allied to *Syzygium ugoense* (C. B. Rob.) Airy Shaw, but that species has smaller, distinctly acuminate, epunctate leaves. It is possible, because of the bract and bracteole characters, that its real alliance is with the group of *Syzygium fastigiatum* (Blume) Merr. and Perr. in spite of its very small leaves.

SYZYGIUM SURIGAENSE (Merr.) comb. nov.

Eugenia surigaensis Merr., Philip. Jour. Sci. 18 (1921) 297, Enum. 3 (1923) 178.

A species known only from the type collection, *Bur. Sci. 34686 Ramos* and *Pascasio,* from Surigao Province, Mindanao.

SYZYGIUM TAYABENSE (Quis. and Merr.) comb. nov.

Eugenia tayabensis Merr. and Quis., Philip. Jour Sci. 37 (1928) 175.

A species known only from the type collection, *Bur. Sci. 45691 Ramos* and *Edaño.,* from (Quezon) Tayabas Province, Luzon.

SYZYGIUM TAYTAYENSE (Merr.) comb. nov.

Eugenia taytayensis Merr., Philip. Jour. Sci. 10C (1915) 223, Enum. 3 (1923) 178.

The type collection is *Merrill 9201* from Palawan. A second Palawan collection is *For. Bur. 27919 Cenabre, Paras* and *Gellidon,* February, 1920, distributed as a new species of *Eugenia* under an unpublished binomial derived from the name of the first of the three collectors.

SYZYGIUM TENUIPES (Merr.) comb. nov.

Eugenia tenuipes Merr., Philip. Jour. Sci. 7C (1912) 316, Enum. 3 (1923) 178.

A species known from several collections from Cagayan Province, Luzon, and Mindoro. Referable is *Bur. Sci. 20155 McGregor* from Nueva Vizcaya Province, *Bur. Sci. 22438 Ramos* from Pampanga Province, distributed as *Eugenia* sp., and *Bur. Sci. 41997 Ramos* from Rizal Province, Luzon.

SYZYGIUM TENUIRAME (Miq.) comb. nov.

Jambosa tenuiramis Miq., Fl. Ind. Bat. 1^1 (1855) 437.

Eugenia longicauda Ridl., Jour. Straits Br. Roy. As. Soc. 6 (1912) 7.

Eugenia nitidissima Merr., Philip. Jour. Sci. 10C (1915) 213, Enum. 3 (1923) 172.

Eugenia spicata Lam. var. *tenuiramis* Henders., Gard. Bull. Singapore 12 (1949) 252.

This species is recorded from within the Philippines as (*Eugenia nitidissima* Merr.) from Leyte, Negros, Panay, and Mindanao, the type of my species being *Wenzel 922* from Leyte. Two additional collections are *Bur. Sci. 84014, 84064, Ramos* and *Convocar* from Biliran. Henderson gave its distribution as Sumatra, Malay Peninsula, and the Philippines, but, like myself, he did not see Miquel's type which was a Junghuhn specimen from Tapanoeli, Sumatra; but he did see the Teysmann coastal collection from Siboga, referred to this species by Miquel, op. cit. Suppl. (1862) 311. He notes that typical *Eugenia spicata* Lam. = *Syzygium zeylanicum* (Linn.) DC. is a low altitude coastal species in Malaysia, which does not occur in the Philippines, and that *Eugenia longicauda* Ridl. in the Malay Peninsula occurs inland at altitudes from 1,600 to 5,000 feet, while the Philippine *Eugenia nitidissima* Merr. is also an inland species occurring at altitude from 300 to 900 m. Miquel's description indicates the leaves of his species as very long attenuate-caudate, 2 to 2¾ inches long and 2½ to 4 lines wide, and his description otherwise agrees very closely with the Philippine form. However, I have seen no Bornean specimens that I can refer to Miquel's species as it is at present understood, and for the present prefer to retain the form as of specific rank, rather than to treat it as a variety of *Eugenia* Lam. = *Syzygium zeylanicum* (Linn.) Merr. and Perr. as Henderson did. The apparent absence of the species from Borneo is puzzling.

SYZYGIUM TOPPINGII (Elm.) comb. nov.

Eugenia toppingii Elm., Leafl. Philip. Bot. 4 (1912) 1407; Merr., Enum. 3 (1923) 178.

Eugenia puncticulata Merr., Philip. Jour. Sci. 9C (1914) 381.

A species known from Leyte and Mindanao; *Elmer 11181, Wenzel 369, 384* to be compared with *S. balerense* (C. B. Rob.) Merr.

SYZYGIUM TRIANTHUM (Merr.) comb. nov.

Eugenia triantha Merr., Philip. Jour. Sci. 10C (1915) 224, Enum. 3 (1923) 178.

A species known from two collections from Mindanao (Butuan) and Basilan, *For. Bur. 20558 Miranda, 26417 Tecson.*

SYZYGIUM TRIPHYLLUM (C. B. Rob.) comb. nov.

Eugenia triphylla C. B. Rob., Philip. Jour. Sci. 4C (1909) 371; Merr., Enum. 3 (1923) 179.

A species known only from several collections from Mindanao (Zamboanga, Lanao) and Basilan. A recent collection is *Ebalo 832* from Zamboanga. A very unusual character of this species is that its leaves are in whorls of three, not opposite.

SYZYGIUM TRIPINNATUM (Blanco) comb. nov.

Myrtus tripinnata Blanco, Fl. Filip. (1837) 421.
Myrtus subrubens Blanco, op. cit. ed. 2 (1845) 294.
Eugenia tripinnata C. B. Rob., Philip. Jour. Sci. 4C (1909) 357; Merr., Enum. 3 (1923) 179.
Eugenia peninsula [*ris*] Elm., Leafl. Philip. Bot. 10 (1939) 3769 decr. angle, *syn. nov.*

One of the most widely distributed Philippine species, amply represented by numerous collections, extending from northern Luzon to southern Mindanao. After a critical examination of eight sheets representing the four numbers on which *Eugenia peninsula* [*ris*] Elm. was based (*Elmer 15421, 15441, 15968, 15991*) I can detect no characters by which it can be distinguished from the species Blanco characterized in 1837. All of these Elmer specimens are unsatisfactory, as the inflorescences and infructescences are represented by detached fragments, but both flowers and fruits are present; it is of course possible that two species may be represented by the cited numbers. Elmer described this as *Eugenia "peninsula"* when he should have used the form *peninsularis*, as the name was derived from the Sorsogon Peninsula, the most southern part of Luzon.

SYZYGIUM TULA (Merr.) comb. nov.

Eugenia tula Merr., Philip. Jour. Sci. 18 (1921) 297, Enum. 3 (1923) 179.

The type collection was *For. Bur. 27540 De Mesa,* from Davao Province, Mindanao. Additional collections are *For. Bur. 21889 Villamil* from Zamboanga, *25690 Tecson* from Basilan (erroneously distributed as *Eugenia bordenii* Merr.), and the recently collected *Ebalo 562* from Palawan, and *P. N. H. 10361 Mendoza* and *Convocar* from Surigao.

SYZYGIUM UGOENSE (C. B. Rob.) Airy Shaw

Syzygium ugoense (C. B. Rob.) Airy Shaw, Kew Bull. (1949) 120.
Eugenia ugoensis C. B. Rob., Philip. Jour. Sci. 4C (1909) 389.
Eugenia myrtillus sensu, Merr., Enum. 3 (1923) 172, non Staf.

This species was based on three collections from Mount Ugo, Benguet Province, Luzon, and has not appeared in recent collections. I had erroneously reduced it to the Bornean *Syzygium myrtillus* (Stapf) Merr. and Perr. of Borneo, but defer to Airy Shaw's judgment who had the opportunity of examining Stapf's type at Kew.

SYZYGIUM URDANETENSE (Elm.) comb. nov.

Eugenia urdanatensis Elm., Leafl. Philip. Bot. 7 (1914) 2365; Merr., Enum. 3 (1923) 179.

Eugenia caudatifolia Merr., Philip. Jour. Sci. 10C (1915) 211, Enum. 3 (1923) 162, *syn. nov.*

Eugenia capizensis Merr., op. cit. 18 (1921) 305, Enum. 3 (1923) 161, *syn. nov.*

With ample material representing the three supposedly distinct species I now see no valid reason for recognizing more than one, and accordingly reduce *Eugenia capizensis* Merr. and *E. caudatifolia* Merr. as synonyms of Elmer's earlier described species. Additional collections are *Wenzel 3137* from Surigao Province, Mindanao, *Bur. Sci. 84045 Ramos* and *Convocar* from Dinagat, *P. N. H. 5787 Castro, 6457 Sulit* from Samar, and *P. N. H. 10621 Mendoza* and *Convocar* from Agusan. The known range is now Luzon (Quezon, Camarines), Leyte, Panay, Dinagat, Bucas Grande, Catanduanes, and northeastern Mindanao.

SYZYGIUM VACCINIFOLIUM nom. nov.

Eugenia vaccinioides Elm., Leafl. Philip. Bot. 7 (1914) 2350; Merr., Enum. 3 (1923) 179, non *Syzygium vaccinioides* Merr. and Perr. (1942).

LUZON (Quezon) and Mindanao (Agusan), the type collection being *Elmer 13760*. A new name is needed in *Syzygium* because of the Papuan *Syzygium vaccinioides* Merr. and Perr. (1942).

SYZYGIUM VALDEPUNCTATUM sp. nov.

Ut videtur arbor parva, glabra, ramis ramulisque glabris, ultimis circiter 1.5 mm. diametro, pallide brunneis; foliis stricte oppositis, oblongo-ellipticis, firmiter chartaceis, 10–14 cm. longis, 3–5–6 cm. latis, breviter obtuse acuminatis, basi acutis vel late acutis, supra subolivaceis, subtus pallide brunneis et distincte subdense glanduloso-punctatis, glandulis leviter elevatis; nervis primariis utrinque circiter 20, supra planis vel obscure elevatis, subtus elevatis, inter se 5–10 mm. distantibus, quam secondariis reticulatisque paullo distinctioribus, in venam submarginalem distinctam, 1 mm. a margine distantem confluentibus; petiolo 1–2 cm. longo; inflorescentiis terminalibus, et in axillis superioribus, sub fructu 2.5–4 cm. longis, e basi ramosis, ut videtur paucifloris; floribus ignotis; fructibus maturis urceolato-globosis, sessilibus, pallide brunneis, basi latissime rotundatis, estipitatis, 5 mm. diametro, calycis tubo lato, circiter 1 mm. longo, lobis late triangularis, acutis, vix 1 mm. longis.

MINDANAO, District of Zamboanga, *For. Bur. 26144 Bábaran*, July, 1916, type herb. Arnold Arboretum, isotypes at Kew and in the United States National Herbaria.

This species is manifestly allied to *Syzygium pustulatum* (Duthie) comb. nov. (*Eugenia pustulata*) Duthie in Hook. f. Fl. Brit. Ind. 2 (1878) 495, of the Malay Peninsula, but it differs in so many points that I do not hesitate to describe it as new. Henderson, Gard. Bull. Singapore 12 (1949) 188, described the fruits of Duthie's species as "oblong globose c. 1.3 cm. long . . . fringed by the 4 erect, somewhat enlarged calyx lobes." The venation of this Philippine species is very different from that of the Malay Peninsula form, as it is also from the allied *Syzygium perpuncticulatum* (Merr.) Merr. and Perr. of Borneo, which Henderson reduces to the synonymy of *Eugenia pustulata* Duthei. This is admittedly in the alliance of Duthie's species but with ample material for comparison, both from Borneo and the Malay Peninsula, I hesitate to accept this reduction of *S. perpuncticulatum* Merr. and Perr. The very strongly impressed nerves on the upper leaf surfaces of the Bornean form is strikingly different from the characters of the Malay Peninsula plant of which eight specimens are before me, for in that form the nerves are not at all or only very slightly impressed *Syzygium halophilum* (Merr.) Merr. suggests the present species in its vegetative characters but its leaves are obscurely puncticulate, and its calyces are strongly narrowed below.

SYZYGIUM VERNONIOIDES (Elm.) comb. nov.

Eugenia vernonioides Elm., Leafl. Philip. Bot. 7 (1914) 2352; Merr., Enum. 3 (1923) 179.

The type of this was *Elmer 13826* from Agusan Province, Mindanao. A second and recent collection is *P. N. H. 6803 Edaño* from Negros.

SYZYGIUM VIDALIANUM (Elm.) comb. nov.

Eugenia vidaliana Elm., Leafl. Philip. Bot. 2 (1909) 584; C. B. Rob., Philip. Jour. Sci. 4C (1909) 372; Merr., Enum. 3 (1923) 179, excl. syn. *Eugenia williamsii* C. B. Rob.

Eugenia sorsogonensis Merr., Philip. Jour. Sci. 11C (1916) 22.

A species known from Luzon (Quezon, Sorsogon). A recent collection is *P. N. H. 2684 Sulit* from Sorsogon Province, Luzon.

SYZYGIUM VULCANICUM Elm. sp. nov.

Eugenia vulcanica Elm., Leafl. Philip. Bot. 10 (1939) 3808. *nom.* pro. syn. *E. livida* Elm.

Eugenia bulusanensis Elm., op. cit. 9 (1925) 3185, *nom.* in obs., 10 (1939) 3808 *nom.* pro. syn. *E. livida* Elm.

§ *Jambosæ.* Arbor glabra, ramis ramulisque pallidis, teretibus, ultimis circiter 1 mm. diametro, interdum obscure compressis vel sulcatis, haud angulatis; foliis oppositis, coriaceis, plerumque oblongis, vel oblongo-lanceolatis vel oblongo-ellipticis 5–13 cm. longis, 1.5–4 cm. latis, utrinque subaequaliter angustatis, basi acutis, apice distincte el plerumque subobtuse acuminatis, in sicco supra olivaceis, opacis, subtus pallidioribus, epunctatis: nervis lateralibus utrinque 5–7, gracilibus, supra obscuris, subtus leviter elevatis, distantibus, leviter curvato-adscendentibus, in venam submarginalem 1.5–3.5 mm. a margine confluentibus, secundariis paucis, haud perspicuis, reticulis laxis, plerumque subobsoletis; petiolo 3–6 mm. longo; inflorescentitis ut videtur caulinis et fasciculatis, 5–7 cm. longis pedunculatis paucifloris, floribus quam in *S. mananquil* (Blanco) Merr. (*Eugenia livida* Elm.) circiter duplo majoribus, plerumque in triadibus dispositis, pedicellis superioribus 6–8 mm. longis, inferioribus (si praesente) 1.5–2 cm. longis, bracteolis ut videtur minutis, deciduis; calycibus circiter 1 cm. longis, tubo deorsum angustato, ore ad 8 mm. diam., minute et obscure glanduloso-verruculosis, lobis suborbicularis, late rotundatis, ad 5 mm. diametro, extus obscure glanduloso-verruculosis, incrassatis; petalis orbiculari-obvatis, rotundatis, liberis, epunctatis, circiter 5 mm. diametro, staminibus numerosis filamentis ad 13 mm. longis, antheris oblongis, 1.8 mm. longis; stylo circiter 1.5 cm. longo; fructibus suburceolatis, ad 2 cm. longis et 1.5 cm. diametro, tubo distincte producto et 1 cm. lato.

LUZON, Sorsogon Province, Mount Bulusan, Elmer *16997* (type, Arnold Arboretum, isotypes in the Gray Herbarium and U. S. National Herbarium), *Elmer 17318* (fruiting specimen) *15013* (in the three herbaria above listed), collected in August and September, 1916. The last two numbers were distributed as *Eugenia bulusanensis* Elm.

I have hesitated in characterizing this species because of the unsatisfactory nature of the nine specimens before me, the inflorescences and infructescences being represented by badly broken detached fragments. Mr. Elmer's notes are lost. It is difficult to understand why he placed both *E. vulcanica* Elm. and *E. bulusanensis* Elm. as synonyms of *Eugenia livida* Elm. which is clearly the same as *E. mananquil* Blanco = *Syzygium mananquil* Merr., because of the numerous differences between the two. While no evidence of attachment of the inflorescences is available I have assumed them to be cauline and fascicled, otherwise it is scarcely possible that Mr. Elmer would have referred the specimens to *Eugenia livida* Elm. I have accepted *Eugenia vulcanica* Elm. as the source of the specific name, and the description includes the larger leaf characters of Elmer's type as well as the smaller and more crowded leaves of what he called *Eugenia bulusanensis* Elm. I am convinced that but a single species is presented by the three collections. In the type the ultimate internodes are 2 to 3 cm. long, but in the other numbers cited they usually do not exceed 1 cm. in length. I take it that the larger leaved form was perhaps growing under more favorable conditions than the form with smaller leaves.

SYZYGIUM WENZELII (Merr.) comb. nov.

Eugenia wenzelii Merr., Philip. Jour. Sci. 9C (1914) 380, Enum. 3 (1923) 180.

The type is *Wenzel 770* from Leyte. It was also recorded from Quezon Province, Luzon. Additional collections are *Bur. Sci. 23033 McGregor* from Laguna Province, Luzon and *For. Bur. 21656, 21667 Sherfeesee, Cenabre* and *Ponce* from Surigao Province, Luzon. The species is very similar to *Syzygium rhamphiphyllum* (Craib) C. E. C. Fischer of Burma, Siam and the Malay Peninsula.

SYZYGIUM WHITFORDII (Merr.) comb. nov.

Eugenia whitfordii Merr., Manila, Govt. Lab. Publ. 35 (1906) 49, Enum. 3 (1923) 180.

A species known only from Luzon (Bataan, Laguna, and Camarines Provinces.), *Whitford 468, For. Bur. 1182, Borden, Merrill Philip. Pl. 1527*, etc.

SYZYGIUM WILLIAMSII (C. B. Rob.) comb. nov.

Eugenia williamsii C. B. Rob., Philip. Jour. Sci. 4C (1909) 365.

The type is *Williams 2128* from the Zamboanga Peninsula, Mindanao. In my Enumeration 3 (1923) 179, this was erroneously reduced to *Eugenia vidaliana* Elm. The Zamboanga and Basilan numbers there cited belong with *S. williamsii* (C. B. Rob.) Merr. An additional collection is *For. Bur. 24558 Tecson* from Zamboanga.

SYZYGIUM XANTHOPHYLLUM (C. B. Rob.) comb. nov.

Eugenia xanthophylla (C. B. Rob.) Philip. Jour. Sci. 4C (1909) 370; Merr., Enum. 3 (1923) 180.

A common species extending from northern Luzon (Cagayan) to Mindanao. A recent collection is *P. N. H. 6079 Sulit* from Samar.

SYZYGIUM XIPHOPHYLLUM (Merr.) comb. nov.

Eugenia xiphophylla Merr., Philip. Jour. Sci. 18 (1921) 298, Enum. 3 (1923) 180.

A very characteristic species known only from Mindanao (Lanao, Zamboanga). *Bur. Sci. 36872, 36979 Ramos* and *Edaño,* etc.

SYZYGIUM ZAMBOANGENSE (C. B. Rob.) comb. nov.

Eugenia zamboangensis C. B. Rob., Philip. Jour. Sci. 4C (1909) 379; Merr., Enum. 3 (1923) 180.

A species limited to Mindanao (Surigao, Zamboanga), and Basilan. An additional collection is *For. Bur. 22843 Ponce* from Surigao Province, Mindanao. The number later assigned to the cited *Hallier* collection is *583.*

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STUDIES ON THE CONTROL OF FECAL-BORNE DISEASES IN NORTH CHINA

XVII. AN APPROACH TO THE QUANTITATIVE STUDY OF THE HOUSE FREQUENTING FLY POPULATION

E. THE FOOD PREFERENCES OF THE COMMON NORTH CHINA FLIES

By CH'ING HUA MENG AND GERALD F. WINFIELD
Of the Department of Biology, Cheeloo University,
Tsinan, Shantung, China

I. INTRODUCTION

In the previous papers of this subseries dealing with the quantitative study of the house frequenting fly population (Meng and Winfield, 1941, 1941a, 1950, and 1950a) information on the distribution, density and breeding habits of the common North China flies was presented. It was shown that there is a close relationship between the rate of breeding in the available media and the number of the adult flies in the population during the different months of the fly season. The other important factor which determined the distribution of the flies in the community is their preference for food materials. Food preferences, along with reaction to light and other environmental factors, largely determine the species and the number of flies which enter houses or courtyards, for the urge to seek food and the urge to breed are the two forces which cause most of the movement of the fly population.

Not only do food preferences play an important part in determining the distribution of the house frequenting fly population but they also determine largely the extent to which flies may act as carriers of disease to human beings. The habit of many species of flies of visiting human feces and then feeding on human food is well known as the means of carrying pathogenic organisms and needs no argument. The feeding habits of the important domestic flies have been studied in more or less detail by a great many workers. Information on the food preferences of species which occur in China has been given by several authors such as Awati and Swaminanth (1920), Patton (1928 and 1930), and Lorincz and coworkers (1936). However, few observations or experiments done in China have as yet been reported. Patton (1930) reported that *Chrysomyia megacephala* is commonly seen on food stuffs, particularly on fruits, especially water melons, in North China. Because of the importance of food preferences both in determining the distribution of the fly population and as a factor in the spread of disease organisms,

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three experiments designated to test the food preferences of the common flies were carried out in Tsinan. This paper gives the report of the results obtained.

II. MATERIALS AND METHODS

The method used in determining the food preferences of the common flies was to bait standard traps with equal amounts of the different food materials being tested. These were put at equal distances from each other in a place where flies were abundant. Three such experiments were carried out. The traps were set at the composting station at Hsin Chuang where large numbers of flies were attracted by the feces and manure which were being used in the composting experiments. A total of nine different food combinations were tested in the three experiments. They were (1) decaying beef, (2) bread, sugar, and vinegar bait, (3) human feces, (4) city garbage, (5) mixed cooked foods, (6) mixed human feces and pig, horse, and cow manure (7) pig manure, (8) horse manure, and (9) cow manure,

In Experiment 1 twenty different trappings were carried out for varying lengths of time on twenty different days during August and early September of 1936 by using four materials as bait for traps. The materials used were decaying beef, bread-sugar-vinegar bait, human feces, and city garbage. Because the lengths of the trapping periods varied on the different days, the results are reported in terms of mean number of flies caught per trapping hour.

Experiment 2 was done in September and early October, 1936 and consisted of 20 trappings of exactly 8 hours each. Three types of food were used, namely, a mixture of cooked food commonly used in Tsinan, city garbage, and a mixture of human feces, and pig, horse, and cow manure. The data for this experiment are reported as the number of flies caught per 8 hours since all trapping periods were of the same duration.

Experiment 3 was done during July to September, 1937 and consisted of forty 8-hour trappings. Six different food mixtures were used, namely, mixed cooked food, city garbage, human feces, pig manure, horse manure, and cow manure. The data for this experiment are reported as flies caught per 8-hour day.

The flies attracted to each type of food material and caught in each trap were counted, identified to species, and their sex determined. When there were only few flies caught all of them were counted, otherwise a representative portion by weight was counted and identified and the total number belonging to each species calculated.

III. PRESENTATION OF DATA

The materials tested in these three experiments were of two classes, namely, foods and breeding media. The attraction exerted, therefore, was both as food and as medium for oviposition. The results obtained will be presented in two sections. The first represents the total number of flies caught when each food material was used as bait while the second represents the sexes of the flies caught. This second section will help indicate how much the breeding factor affected the catch as against food preference alone. Only the eggs and first larvae deposited in the decaying beef used in Experiment 1 were bred and the species determined. The flies bred from that material are shown in Table 1 of the preceding paper of this series (Meng and Winfield, 1950a).

The total number of flies caught in each of the three experiments were 23,602; 6,767; and 20,965 respectively. Although the number of trappings and the kinds of food used in the third experiment were twice and one and one thrid as much respectively as in Experiment 1, yet the total catch of the latter exceeded that of the former. This may have been due in part, to the difference in the numbers of flies present in the area where the experiments were done during the two seasons. It seems likely that it was also due to the much greater attractiveness of decaying beef and bread-sugar-vinegar bait combination for many flies. These materials were used in Experiment 1 but not in Experiment 3. The catch in Experiment 2 was small due to the late season and to the fact that only three kinds of baits were used.

1. THE ATTRACTIVENESS OF THE DIFFERENT FOODS TO EACH SPECIES OF FLY AS MEASURED BY THE TOTAL NUMBER CAUGHT

The mean number of the different species of flies caught per hour or per eight-hour period with the standard error of the mean for each experiment is shown in Tables 1 to 3. These tables also show the differences between the means for the different foods and the statistical test for significance. A study of these tables shows the following results for the various species.

1. *Musca vicina.*—The first experiment showed that decaying beef was less attractive to *M. vicina* than bread, sugar, and vinegar bait but the difference was not significant. Both bread-sugar-vinegar bait combination and decaying beef were signifi-

cantly more attractive than either garbage or human feces, while garbage and feces were about equally attractive. Experiment 2 showed that mixed cooked food was significantly more attractive than the mixture of fecal materials and almost significantly more attractive than garbage. Had it not been for the fact that the number of flies caught was so small because of the lateness of the season when this experiment was done, this difference would have been significant. Garbage was more attractive than the mixture of fecal materials, but the difference was not significant. The third experiment showed that mixed cooked food was significantly more attractive than any other type of material tested, with feces coming next. Both feces and garbage were significantly more attractive than the three types of animal manure which were about equally attractive.

These experiments show that *M. vicina* is attracted more by cooked food than by any of the other materials tested. It is also strongly attracted by decaying beef, garbage, and human feces while the various types of animal manure are least attractive to it. The strong attraction of food for this species undoubtedly plays an important part in causing it to be the dominant species inside the houses. It was shown in the preceding paper of this series (Meng and Winfield, 1950a) that pig manure and feces are the favorite breeding media for this species. The fact that these breeding media were much less effective in attracting flies in the three feeding experiments than was cooked food would seem to indicate that the flies which visited these traps did so primarily in order to search for food. This preference which the house entering muscas have for food and feces as their food and breeding media is the reason this species has long been considered the most important in transmitting the fecal-borne diseases.

2. *Muscina stabulans.*—The first expirement showed that decaying beef was less attractive to *Muscina stabulans* than bread-sugar-vinegar bait although the difference was not significant. Bread-sugar-vinegar bait was significantly more attractive than feces and almost significantly more attractive than garbage. Decaying beef was not significantly more attractive than either feces or garbage which were about equally attractive. Experiment 2 showed that mixed food and garbage were equally attractive while mixed food was signifiacantly more attractive than the mixture of fecal materials. Garbage was not attractive. The third experiment showed that the mixed food was significantly the most attractive material. Feces were significantly

more attractive than garbage and the different types of manure. There were no statistical differences in the attractiveness of garbage and the three types of manure although garbage seems to be the more attractive.

These experiments show that this species is very fond of cooked food, less so of decaying beef, feces, and garbage, and least attracted by animal manure. It is of interest to note that although *M. stabulans* shows about the same reaction to food and breeding materials as *M. vicina*, nevertheless, it is not nearly so common in houses. This is probably due to their difference in reaction to light; *M. stabulans* being less attracted to enter dark places than *M. vicina*.

3. *Chrysomyia megacephala.*—Experiment 1 showed that decaying beef was significantly the most attractive material for this species. Feces and bread-sugar-vinegar bait combination which were equally attractive were significantly more attractive than garbage. The second experiment seemed to show that garbage was more attractive than either mixed food or the mixture of fecal materials, although none of the differences were significant, because of the small numbers of this species trapped. The third experiment showed that mixed food and feces which were about equally attractive, were significantly more attractive than the rest of the materials tested. Garbage was significantly more attractive than the different types of manure.

These comparisons show that this species is very fond of putrefying substances with offensive odors such as decaying beef. It is next attracted to feces, bread-sugar-vinegar bait, cooked food, and garbage. Its fondness for sweet substances such as bread sugar and vinegar bait explains the common observation that this species is attracted to fruits especially water melons. The desire of this fly for food, sweet materials, and feces coupled with the fact that it breeds in liquid feces makes it the dominant fly in the courtyards during the hot summer weather in North China. The presence of large number of this fly during summer when many families sat out of doors, indicates how it may play an important part in the spread of fecal-borne diseases.

4. *Lucilia sericata.*—The first experiment showed that decaying beef was significantly the most attractive material for *L. sericata,* and that bread-sugar-vinegar bait, garbage, and feces were almost equally attractive. Experiment 2 showed that mixed food and garbage were equally attractive and that mixed food was significantly more attractive than the mixture of fecal materials. Garbage was not attractive. In the third experi-

ment feces were significantly the most attractive materials tested. Mixed food was significantly more attractive than garbage and the different types of manure. There was no significant difference between the attractiveness of garbage and the different types of manure although garbage seems the more attractive.

These comparisons show *L. sericata* is very fond of putrefying substance such as decaying beef, less so of feces, bread-sugar-vinegar bait, cooked food, and garbage, and least attracted to animal manure. That this species was attracted to decaying beef for oviposition is shown by the fact that 32.1 per cent of flies bred from the beef used in Experiment 1 belonged to this species (Meng and Winfield, 1950a, Table 1).

TABLE 1.—*Showing the mean number of flies caught per hour in traps using various food materials for bait, 20 trappings, August and September, 1936.*

Musca vicina

Food	Mean	Sigma
B.S.V.* (Ba.)	9.80	2.90
Beef (B.)	4.20	1.26
Garbage (G.)	0.88	0.40
Faeces (F.)	0.63	0.20
	D	D/σD
Ba. vs. B.	5.60	1.77
Ba. vs. G.	8.92	*3.05*
Ba. vs. F.	9.17	*3.15*
B. vs. G.	3.32	*2.51*
B. vs. F.	3.57	*2.80*
G. vs. F.	0.25	0.56

Muscina stabulans

Food	Mean	Sigma
Ba.	5.79	2.03
B.	2.88	0.61
F.	1.67	0.46
G.	1.58	0.64
	D	D/σD
Ba. vs. B.	2.91	1.37
Ba. vs. F.	4.12	*2.05*
Ba. vs. G.	4.21	1.98
B. vs. F.	1.21	1.59
B. vs. G.	1.30	1.47
F. vs. G.	0.09	0.10

Chrysomyia megacephala

Food	Mean	Sigma
B.	44.80	7.24
F.	8.61	2.60
Ba.	8.50	2.04
G.	2.95	0.94
	D	D/σD
B. vs. F.	36.19	*4.70*
B. vs. Ba.	36.30	*4.82*
B. vs. G.	41.85	*5.73*
F. vs. Ba.	0.11	0.03
F. vs. G.	5.66	*2.05*
Ba. vs. G.	5.54	*2.46*

Lucilia sericata

Food	Mean	Sigma
B.	10.16	2.76
G.	1.25	0.70
Ba.	1.09	0.29
F.	0.86	0.20
	D	D/σD
B. vs. G.	8.91	*3.13*
B. vs. Ba.	9.07	*3.27*
B. vs. F.	9.30	*3.36*
G. vs. Ba.	0.15	0.20
G. vs. F.	0.39	0.53
Ba. vs. F.	0.23	0.65

Lucilia caesar

Food	Mean	Sigma
B.	0.64	0.22
G.	0.19	0.11
F.	0.13	0.04
Ba.	0.10	0.06
	D	D/σD
B. vs. G.	0.45	1.80
B. vs. F.	0.51	*2.27*
B. vs. Ba.	0.54	*2.32*
G. vs. F.	0.06	0.53
G. vs. Ba.	0.09	0.69
F. vs. Ba.	0.02	0.33

Sarcophaga spp.

Food	Mean	Sigma
B.	11.30	1.31
F.	6.78	1.27
Ba.	5.64	1.12
G.	1.92	0.81
	D	D/σD
B. vs. F.	4.52	*2.47*
B. vs. Ba.	5.67	*3.28*
B. vs. G.	9.38	*6.08*
F. vs. Ba.	1.15	0.67
F. vs. G.	4.86	*3.23*
Ba. vs. G.	3.72	*2.69*

Musca sorbens

Food	Mean	Sigma
F.	0.69	0.27
B.	0.23	0.08
Ba.	0.17	0.06
G.	0.12	0.05
	D	D/σD
F. vs. B.	0.46	1.64
F. vs. Ba.	0.52	1.90
F. vs. G.	0.57	*2.10*
B. vs. Ba.	0.06	0.59
B. vs. G.	0.11	1.18
Ba. vs. G.	0.05	0.63

* Bread, sugar, and vinegar bait.

TABLE 2.—*Showing the mean number of flies caught per 8-hour trapping in traps using various food materials for bait, 20 trappings, September and October, 1936.*

Musca vicina			*Muscina stabulans*			*Lucilia sericata*		
Food	Mean	Sigma	Food	Mean	Sigma	Food	Mean	Sigma
Mixed food (F.)	80.70	31.20	F.	79.10	20.77	G.	6.80	4.10
Garbage (G.)	16.85	9.72	G.	76.35	42.36	F.	5.95	1.71
Mixed feces (Fe.)	1.25	0.32	Fe.	6.85	8.65	Fe.	0.70	0.22
	D	D/σD		D	D/σD		D	D/σD
F. vs. G.	63.85	1.95	F. vs. G.	2.75	0.06	G. vs. F.	0.85	0.19
F. vs. Fe.	79.45	*3.54*	F. vs. Fe.	72.25	*3.42*	G. vs. Fe.	6.10	1.48
G. vs. Fe.	15.60	1.60	G. vs. Fe.	69.50	1.63	F. vs. Fe.	5.25	*3.05*
Chrysomyia megacephala			*Sarcophaga spp.*			*Musca sorbens*		
Food	Mean	Sigma	Food	Mean	Sigma	Food	Mean	Sigma
G.	14.25	7.07	F.	10.80	2.37	F.	2.00	0.71
F.	5.25	1.49	G.	10.10	5.44	G.	0.85	0.33
Fe.	2.95	1.04	Fe.	6.95	2.85	Fe.	0.60	0.41
	D	D/σD		D	D/σD		D	D/σD
G. vs. F.	9.00	1.24	F. vs. G.	0.70	0.11	F. vs. G.	1.15	1.46
G. vs. Fe.	11.30	1.58	F. vs. Fe.	3.85	1.03	F. vs. Fe.	1.40	1.70
F. vs. Fe.	2.30	1.26	G. vs. Fe.	3.15	0.51	G. vs. Fe.	0.25	0.40

5. *Lucilia caesar.*—The first experiment indicated that decaying beef was significantly more attractive to *L. caesar* than either bread-sugar-vinegar bait or feces and was almost significantly more attractive than garbage. Bread-sugar-vinegar bait, garbage, and feces were about equally attractive. In the second experiment so few of this species were caught that no comparisons were made. Experiment 3 showed that mixed food was significantly the most attractive material. Feces were more attractive than garbage and cow manure. Garbage was more attractive than cow manure although the difference was not significant. This species was not attracted to pig and horse manure.

These comparisons show that this species is very fond of decaying beef, less fond of cooked food, feces, bread-sugar-vinegar bait, and garbage, and least fond of animal manure.

6. *Sarcophaga.*—The first experiment showed that decaying beef was significantly the most attractive material for the species of this genus. Feces and bread-sugar-vinegar bait which were equally attractive were significantly more attractive than garbage. Experiment 2 showed no significant differences between the three materials tested although mixed food and garbage attracted more Sarcophagas than did the mixture of feces. In the third experiment feces was significantly the most attractive material. Mixed food was significantly more attractive than garbage and the different types of manure, while garbage was more attractive than the three types of manure.

These comparisons indicate that this genus was represented by species which are very fond of putrefying substances with offensive odor such as decaying beef; quite fond of substances with strong odor such as feces and bread-sugar-vinegar bait, and less attracted to cooked food, garbage and animal manure. As was the case with *L. sericata* the urge to oviposit played an important part in the attractiveness of decaying beef for the species of this genus since 65.8 per cent of the flies bred from the beef used as bait in Experiment 1 belonged to the genus *Sarcophaga*.

7. ***Musca sorbens***.—In the first experiment feces was significantly more attractive to *Musca sorbens* than garbage, and almost significantly more attractive than bread, sugar and vinegar bait. There were no significant differences between decaying beef, bread-sugar-vinegar bait, and garbage. In Experiment 2 mixed food seems to be more attractive than either garbage or the mixture of fecal materials but is not so significant. The third experiment showed that feces was significantly most attractive as compared with all other materials. Cooked food was

TABLE 3.—*Showing the mean number of flies caught per 8-hour trapping in traps using various food materials for bait, 40 trappings, July to September, 1937.*

Musca vicina

Food	Mean	Sigma
Mixed food (F.)	26.88	5.68
Feces (Fe.)	2.78	0.78
Garbage (G.)	1.60	0.59
Cow manure (C.)	0.38	0.09
Pig manure (P.)	0.33	0.15
Horse man. (H.)	0.20	0.09
	D	D/σD
F. vs. Fe.	24.15	*4.21*
F. vs. G.	25.27	*4.42*
F. vs. C.	26.50	*4.66*
F. vs. P.	26.55	*4.66*
F. vs. H.	26.67	*4.69*
Fe. vs. G.	1.12	1.19
Fe. vs. C.	2.85	*3.18*
Fe. vs. P.	2.40	*3.20*
Fe. vs. H.	2.52	*3.41*
G. vs. C.	1.22	*2.04*
G. vs. P.	1.27	*2.09*
G. vs. H.	1.40	*2.33*
C. vs. P.	0.05	0.28
C. vs. H.	0.17	1.38
P. vs. H.	0.12	0.70

Muscina stabulans

Food	Mean	Sigma
F.	32.48	5.70
Fe.	15.93	4.24
G.	2.73	1.37
H.	0.03	0.11
C.	0.28	0.09
P.	0.28	0.09
	D	D/σD
F. vs. Fe.	16.55	*2.33*
F. vs. G.	29.75	*5.01*
F. vs. H.	32.17	*5.62*
F. vs. C.	32.20	*5.62*
F. vs. P.	32.25	*5.64*
Fe. vs. G.	13.20	*3.06*
Fe. vs. H.	15.62	*3.68*
Fe. vs. C.	15.65	*3.69*
Fe. vs. P.	15.70	*3.71*
G. vs. H.	2.42	1.40
G. vs. C.	2.40	1.41
G. vs. P.	2.50	1.46
H. vs. C.	0.02	0.03
H. vs. P.	0.07	0.10
C. vs. P.	0.05	0.07

Lucilia sericata

Food	Mean	Sigma
Fe.	38.60	7.51
F.	11.88	2.27
G.	1.45	0.51
P.	0.18	0.05
H.	0.10	0.05
C.	0.10	0.06
	D	D/σD
Fe. vs. F.	26.72	*3.76*
Fe. vs. G.	37.15	*5.87*
Fe. vs. F.	38.47	*6.18*
Fe. vs. H.	38.50	*6.18*
Fe. vs. C.	38.50	*6.18*
F. vs. G.	10.42	*3.18*
F. vs. P.	11.75	*3.39*
F. vs. H.	11.77	*3.40*
F. vs. C.	11.77	*3.40*
G. vs. P.	1.32	1.06
G. vs. H.	1.35	1.08
G. vs. C.	1.35	1.08
P. vs. H.	0.08	0.05
P. vs. C.	0.02	0.05
H. vs. C.	0.00	0.00

Chrysomyia megacephala

Food	Mean	Sigma
F.	118.05	24.76
Fe.	92.53	14.25
G.	14.53	6.63
C.	0.73	0.47
H.	0.38	0.13
P.	0.15	0.06

Sarcophaga spp.

Food	Mean	Sigma
Fe.	75.55	12.19
F.	35.00	9.42
G.	4.88	1.38
C.	0.40	0.11
H.	0.28	0.10
P.	0.28	0.08

Musca sorbens

Food	Mean	Sigma
Fe.	12.45	2.47
F.	5.93	1.97
G.	0.15	0.07
H.	0.10	0.05
P.	0.05	0.08
C.	0.03	0.03

TABLE 3.—*Showing the mean number of flies caught per 8-hour trapping in traps using various food materials for bait, 40 trappings, July to September, 1937*—Continued.

Chrysomyia megacephala Food	Mean D	Sigma D/σD
F. vs. Fe.	25.52	0.89
F. vs. G.	103.52	*4.03*
F. vs. C.	117.32	*4.73*
F. vs. H.	117.67	*4.75*
F. vs. P.	117.90	*4.76*
Fe. vs. G.	78.00	*5.96*
Fe. vs. C.	91.80	*6.44*
Fe. vs. H.	92.15	*6.46*
Fe. vs. P.	92.37	*6.48*
G. vs. C.	13.80	*2.05*
G. vs. H.	14.15	*2.13*
G. vs. P.	14.37	*2.16*
C. vs. H.	0.35	0.72
C. vs. P.	0.57	1.22
H. vs. P.	0.22	1.60

Sarcophaga spp. Food	Mean D	Sigma D/σD
Fe. vs. F.	40.55	*2.63*
Fe. vs. G.	70.72	*5.76*
Fe. vs. C.	75.15	*6.16*
Fe. vs. H.	75.32	*6.17*
Fe. vs. P.	75.32	*6.17*
F. vs. G.	30.17	*3.16*
F. vs. C.	34.60	*3.67*
F. vs. H.	34.77	*3.69*
F. vs. P.	34.77	*3.69*
G. vs. C.	4.42	*3.20*
G. vs. H.	4.60	*3.33*
G. vs. P.	4.60	*3.33*
C. vs. H.	0.17	1.10
C. vs. P.	0.17	1.34
H. vs. P.	0.00	0.00

Musca sorbens Food	Mean D	Sigma D/σD
Fe. vs. F.	6.52	*2.06*
Fe. vs. G.	12.30	*5.00*
Fe. vs. H.	12.35	*5.02*
Fe. vs. P.	12.40	*5.04*
F. vs. C.	12.42	*5.05*
F. vs. G.	5.77	*2.93*
F. vs. H.	5.82	*2.95*
F. vs. P.	5.87	*2.98*
F. vs. C.	5.90	*2.99*
G. vs. H.	0.05	0.62
G. vs. P.	0.10	1.42
G. vs. C.	0.12	1.78
H. vs. P.	0.05	1.00
H. vs. C.	0.07	1.50
P. vs. C.	0.02	0.62

Lucilia caesar Food	Mean	Sigma
F.	3.15	0.36
Fe.	1.53	0.28
G.	0.15	0.09
C.	0.03	0.03
	D	D/σD
F. vs. Fe.	1.62	*3.61*
F. vs. G.	3.00	*3.38*
F. vs. C.	3.02	*3.64*
Fe. vs. G.	1.37	*4.74*
Fe. vs. C.	1.50	*5.35*
G. vs. C.	0.12	1.38

significantly more attractive than garbage and different types of manure. There were no significant differences between the attractiveness of garbage and the different manures.

This species is very fond of feces; less so of cooked food, decaying beef, and-sugar-vinegar bait, and least attracted by garbage and manure.

2. COMPARISONS OF THE ATTRACTIVENESS OF THE DIFFERENT FOODS TO THE MALES AND FEMALES OF EACH SPECIES OF FLIES

Attention has already been called to the fact that most of the materials tested in these experiments not only may serve the flies as food but may also serve as breeding media. If the breeding factor were a dominant one it would be reasonable to expect that more females would be captured than males when breeding media were used as bait, while foods in which no oviposition normally occurs should yield the same number of the two sexes as they occur in the natural population. When the mean number of males and females caught per hour or per day in each of the three experiments together with its standard error were calculated for each species, the following results were obtained.

In all there was a total of 80 cases for comparison of males and females for the different species attracted by the nine different materials. Of these 20 were for the two food materials, namely bread-sugar-vinegar bait and mixed cooked food, while 60 were for the seven materials which may also serve as breeding media. Of the former 17, or 85 per cent, had means for the females which were larger than they were for the males, while only 3 showed a larger catch of males. However, only 3 of the 20, all showing larger numbers of females, were significant statistically. All of the significant comparisons were for the single species *Muscina stabulans*. Of the 60 comparisons that showed differences for the breeding materials, 51 or 85 per cent, showed larger means for the females and 9 showed differences which were significant. Thus the proportion of cases which showed more females caught than males was the same for the two classes of bait as was the proportion of statistically significant differences. It, therefore, seems justifiable to conclude that such differences as were significant were not due to the difference in attraction for the females, which the breeding media might be expected to exert but must be due to other factors. This conclusion is further borne out by the fact that 7 (three with foods and four with breeding media) of the 12 significant cases occurred for the species *Muscina stabulans*, thus suggesting that in the case of this species the females in the area where the experiments were run definitely out numbered the males. This condition possibly may have arisen from a normally longer period of survival on the part of the females as compared with the males. In two of the experiments *Musca sorbens* females were taken in numbers significantly larger than were males when feces was used as a bait. This may indicate that the females of this species are differently attracted by this material. Decaying beef attracted the females of *Musca vicina, Chrysomyia megacephala*, and *Lucilia sericata* in significantly larger numbers than the males of these species. In these cases the breeding stimulus may have been significant. On the whole, however, it seems evident that the feeding stimulus was the more powerful one in causing the flies to seek these baits since the numbers of males caught in 85 per cent of the cases did not differ significantly from the numbers of females. In all experiments for all species, the animal manures were the least attractive of the materials tested.

SUMMARY

The food preferences of seven species of flies commonly found in North China were tested by three experiments in which the number of flies caught per hour (Experiment 1) or per day (Experiments 2 and 3) in traps set equidistant from each other and baited with nine types of food and breeding materials were used to measure the attractiviness of the materials tested. A total of 80 trappings each representing approximately 8 hours were made at the composting station during the summer and fall months of 1936 and 1937, in Tsinan, Shantung, China. The materials tested were (1) decaying beef, (2) bread-sugar-vinegar bait, (3) human feces, (4) city garbage, (5) mixed cooked food, (6) mixed feces and pig, horse, and cow manure, (7) pig manure, (8) horse manure, (9) cow manure. The chief findings were as follows:

1. *Musca vicina* and *Muscina stabulans* were almost identical in their food preferences as tested by this method. They were very fond of cooked food; somewhat less so of decaying beef; less still so of feces and garbage, and least attracted by animal manures.

2. *Chrysomyia megacephala, Lucilia sericata, Lucilia caesar,* and *Sarcophaga* were almost identical in their food preferences. They were very fond of decaying beef; less so of feces, bread-sugar-vinegar bait, mixed cooked food, and city garbage; and least attracted by animal manures.

3. *Musca sorbens* was most attracted by feces; less by mixed cooked food, decaying beef, and bread-sugar-vinegar bait, and least attracted by garbage and animal manure.

4. In 85 per cent of the tests there was no significant difference between the numbers of males and females caught, thus indicating that in most cases the breeding urge was not the dominant one which caused the flies to be attracted by these materials.

5. *Muscina stabulans* females were caught in numbers significantly larger than were the males in 7 out of the 12 tests, 3 of the significant tests occurring with food baits, and 4 occurring with breeding material baits. This difference was probably due to a larger number of females of this species being present in the population at the place where the tests were run.

6. The females of *Musca vicina, Chrysomyia megacephala,* and *Lucilia sericata* were more strongly attracted to decaying beef than were the males of these species, while *Musca sorbens* females were more strongly attracted to feces than were the males.

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BOOKS

Books reviewed here were received from time to time by The Philippine Journal of Science and acknowledged in this section.

Fundamentals of Organic Chemistry. By James Bryant Conant and Albert Harold Blatt. New York, The Macmillan Company, 1950. 413p. Price, $4.

The authors' mission in providing students interested in biology, medicine, agriculture and industry with the fundamentals of organic chemistry is well accomplished. Only those substances which are of importance to biologists, medical men, and industrialists are here considered.

The chief feature of the book is the simple style in which the subject matter is discussed, making it easy for beginners and the inexperienced to acquire the technical and practical information useful to them.

Since it is essential that a beginner be introduced to this complex science by slow stages the subject presentation is very logical, starting with some simple compounds and ending with more complex substances.

Every effort has been exerted in bringing up-to-date the treatment of interesting topics both in the industrial field and in biochemistry. Recent developments in the preparation of synthetic fuels and synthetic rubber are included. Exciting events which concern the general public in connection with medicine and public health are given in the discussion on the most recent drugs such as cortisone, aureomycin, and chloromycetin.

This book should be on the bookshelves of all those engaged in chemistry.—S. S. T.

Engineering Surveys: Elementary and Applied. By Harry Rubey, George Edward Lommel and Marion Wesley Tood. 2nd edition, New York, The Macmillan Company, 1950. 722, 169pp., illus. Price, $5.

The book is one of the Engineering Science Series and of the revised edition. It is, according to the authors, "a practical, up-to-date text and reference book covering material most needed by practicing engineers, adapted to modern trends in surveying instructions for all departments of engineering," and "suitable for either campus classes or surveying camp." The authors have done a creditable work on the subjects discussed.

There are thirty chapters covering important branches of engineering surveys including eleven tables and indexes. The usefulness of the book is increased by the inclusion of Engineering Astronomy and Photogrammetry, subjects which are usually treated separately.

Because of its clear exposition by using numerous data, graphs, pictures and examples to show the application of the methods involved, the book as a whole is a good reference for teachers of vocational and advanced schools teaching the subjects. Surveyors will find the book a very useful companion.—G. O. O.

Laboratory Experiments in Organic Chemistry. By Roger Adams and John R. Hohnson. 4th ed., New York, The Macmillan Company, 1949. 525p. Price, $3.25.

This manual is very practical and as a treatise for beginners the book well serves its purpose. The first part deals with the correct manipulations and methods involved in organic laboratory work. The student not only acquaints himself with the technic but also the important principles involved in the common laboratory procedures. The second part which logically follows gives the preparation and reactions of typical organic compounds.

The authors should be commended for their compilation of experiments representing important general reactions which produce good yields of pure products. Only those requiring relatively inexpensive and available materials were selected without sacrificing other desirable qualities.

Included in this edition are significant commercial developments in the field of synthetics—drugs, resins and insecticides.

The strength of all the commonly used reagents with the necessary precautions as well as the amount of chemicals needed for the experiments are listed thus providing both the student and the teacher a timesaving device.

As a guide and a handy reference for those who teach organic chemistry this book should be very useful.—S. S. T.

Legal Phases of Engineering: Contracts & Specifications. By Ivan C. Crawford. New York. The Macmillan Company, 1950. 346p. Price, $3.75.

Legal Phases of Engineering is a book that should attract the attention of engineers and engineering students, although written primarily for students. It discusses engineering topics together with "legal relations peculiar to the profession—to acquaint the student with their relations in an elementary manner." This, the author fully succeeded in his presentation.

The chapters included: Engineering and the Construction Industry, Sources of American Law, Courts, Evidence, Expert Testimony, Ethics, Contracts, Discharge of Contracts, Business Organization, Real Property, Tort, Agency, Independent Contractor, Sales, Construction Contracts, Steps Leading to the

Award of Contracts, Specifications, Insurance, and Workmen's Compensation Insurance. Forms are given in the appendices to facilitate the preparation of contracts and allied subjects.

Although based on American practices foreign engineers will find the book a good reference and guide. Teachers and professors of the subject will find more materials in the book particularly the cases. To the legal profession, the book is also recommendable.—G. O. O.

Principles of Sedimentation. By W. H. Twenhofel. New York, McGraw-Hill Book Company, Inc., 1950. 673p. illus. Price, $6.50.

This book traces the progress that has been added to the knowledge of sediments and sedimentary processes since the publication of the "Principles of Sedimentation" in 1939 by the same author. Emphasis is placed on a complete consideration of those environmental factors that have major influence in production, deposition and subsequent modification of sediments for a logical understanding of sediments and sedimentary processes.

Among the important topics discussed in this book may be mentioned the following: the environmental factors; classification of environments; origin of inorganic sediments; interrelations of organisms and sediments; transportation and deposition of sediments; classification of sediments, sedimentary rocks, and minerals of sediments; the clastic sediments; sediments of chemical deposition; structural features of sedimentary origin; textures and colors of sediments.

This book is a good reference material for students of geology. It may serve as a guide for geologists and other workers interested in that unexplored field of sedimentation.—A. O. C.

ERRATA

VOLUME 79

Page 63, line 23: Oliver, F. should read Oliver, D.

Page 250, line 14: parentheses in (Ludlow) should be deleted.

Page 251, line 9: (Theobold) should read Theobald with parentheses deleted.

Page 253, lines 7 to 8: all parentheses should be deleted.

Page 256, lines 20 to 23: all parentheses should be deleted.

Page 256, line 28: parentheses in (Doenitz) should be deleted.

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[New names and new combinations are printed in *italics*.]

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